Kitchen Boiler Connections.

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A SELECTION OF

PRACTICAL LETTERS AND ARTICLES

RELATING TO

WATER BACKS AND RANGE BOILERS,

COMPILED FROM

THE METAL WORKER.

FIFTH EDITION, ENLARGED.

DAVID WILLIAMS COMPANY,

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PREFACE.

Among the subjects that have been discussed by the correspondents of The Metal Worker during recent years, none has received more attention or awakened more interest than kitchen or range boilers and water back connections. It is hardly an exaggeration to say that there is a continual stream of inquiries bearing more or less directly upon the topic of water backs sent for publication in The Metal Worker. Those in trouble seek assistance, and their letters call forth explanations and suggestions from practical men all over the United States. The frequency with which assistance is needed in this department of plumbing work, taken in connection with the interest that is shown in the subject, has prompted us to publish in book form a selection of Letter Box inquiries with their answers. To these numerous letters we have added several special articles that have appeared in The Metal Worker bearing upon the same matter of range boilers and water backs and their connection, and have likewise prefaced the divisions of the subject with explanatory remarks where they were deemed necessary. The work is divided into two parts, the first on water backs and boilers and their connections and the second on heating rooms from range boilers, a topic that has much practical interest for the plumber. We believe that this book will appeal to a large number, not only of young plumbers who are desirous of learning, but of old plumbers who have not yet fully mastered the water back arrangement.

The first edition of this book was printed in 1894, and since that time there has been a steady and increasing demand for it. In the meanwhile a great deal of information bearing on the topics treated in the book has appeared in the columns of The Metal Worker, and with a view to making the volume of still greater value, we have in the present edition added largely to the different chapters, and have inserted an entire new one on lime choked water backs. The book contains so much new matter that we feel justified in recommending it even to those who possess a copy of the former edition.

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WATER BACKS AND RANGE BOILERS.

CHAPTER I.

WATER BACKS AND THEIR CONSTRUCTION.

The demand for an ever-ready and practically unlimited supply of hot water has been met by various devices, until what is commonly known as the "water back" and "kitchen boiler" furnish it to-day. It is the English custom to call the water back the "boiler,"

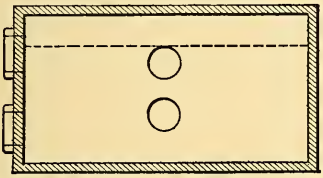


Fig. 1.—Openings Together, One Above the Other.

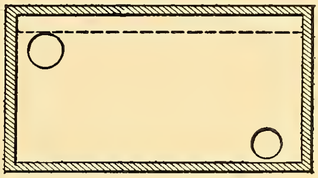


Fig. 2—Openings Separated, One Above the Other.

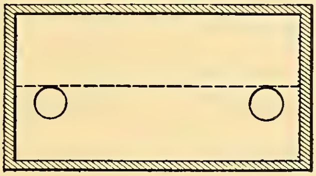


Fig. 3.—Openings Separated on a Line at the Middle.

and "reservoir" or "storage tank" is the name they give the boiler. The water back is sometimes a coil or close loop of wrought iron or copper piping, but more generally a hollow cast iron box having two holes, inlet and outlet, threaded to receive a pipe or brass coupling, to which iron, lead or copper pipe is joined to connect it with the boiler. Sometimes the openings are at the center or at one end, one above the other, Fig. 1, and again at opposite ends, one above the other, Fig. 2, or both on a middle line, as shown in Fig. 3.

The location of the outlet is seldom so arranged as to preven the formation of an air pocket or steam pocket at the top. The dotted lines in the illustrations, Figs. 1, 2 and 3, show the space above the outlet in which the air or steam may collect. Fig. 4 shows a water back designed to provide against such accumulations.

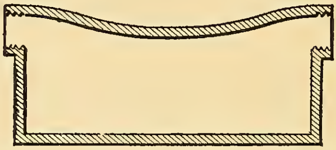


Fig. 4.—Openings at Highest Point.

Frequently there is a partition in the water back, Figs. 5 and 6, to make the water travel a longer distance in contact with the hot surfaces so as to be thoroughly heated in passing through.

A water back should provide by its shape and a partition in it for a continually increasing water way through it to the outlet, and the

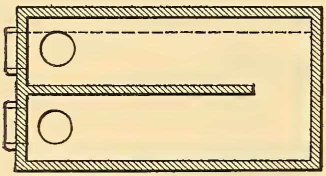


Fig. 5.—Water Back with Horizontal Partition.

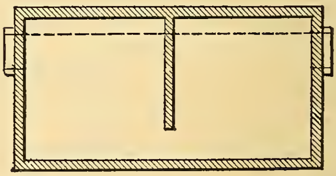


Fig. 6.—Water Back with Vertical Partition.

outlet should be so placed at the highest point as to permit the air and steam to pass off freely.

There are water backs which render good service that are not so constructed; nevertheless they afford opportunity for the collection of air and steam, when excessively heated, that interfere with free circulation and at times cause rumbling, thumping and noise and sometimes burst the piping or the water back.

The water back usually, though not always, is placed in some part of the fire chamber of a kitchen stove, and from the custom of locating it at the back having been so long observed, it is generally

known as the water back. The term "water front" is often used, the meaning of which is obvious. When located at the back of a fire chamber the accumulation of ashes against it impaired its efficiency and the difficulty of removing them led to its being placed at the front and sides. It is preferably located at the side toward which the draft is directed, so that it will be heated by the hot gases passing over it as well as by the fire lying against it. If located on the opposite side, the draft being away from it, the gases do not heat it, and the fire, furthermore, is seldom as hot on that side. Sometimes the water back is suspended over the fire and under the cross piece between the two cooking holes. More often a pipe runs around the fire chamber, just above the lining. When above the fire the flue space of the stove is sometimes contracted at that point; this is a bad arrangement, as it interferes with the draft of the stove. When wood is used for fuel it frequently happens that a water back that has given good results when coal was used will fail to furnish a sufficient quantity of hot water.

PIPE WATER FRONT HEATS TOO MUCH.

From C. S., *Pictou, Can.*—Can you inform me what causes the rattling and jarring in a tank and pipes connected to a range water front constructed of ordinary gas pipe and having a double return? The noise did not occur while another range was coupled to the same pipes and tank, some time since. The only difference between the present and the former work is that the range formerly used contained a cast iron water front. When the noise gets too loud the parties let the water run through the hot faucet.

Answer.—The trouble reported may result from some fault in the construction of the front, or in the manner in which it is placed in the fire box of the range; but we think it is due to the pipe water front having too much heating capacity for the boiler with which it is connected.

The favorite blunder in constructing a pipe water back was to use larger pipe in it than that used in the connections between the back and the boiler, thus making a reduction necessary. This reduction, if placed in the horizontal pipe, leaves an air trap and a place for steam to form when the conditions are favorable. Then, too, pipe coils are much more liable to get out of position than cast backs are, and the fitters must be careful not to strain the coil out of position while screwing up the connections.

We advise our correspondent to examine the coil and see whether there are any points that will not free themselves of air when water is admitted. This defect may exist by the use of a reducing ell or a coupling in the coil, or by the return end of the coil being a little higher than where the pipes enter the range. If this defect is not discovered, the trouble will be found due to restrictions in the connections, too much heating surface, or incrustation of the pipes.

WATER BACK HINDERS BAKING.

From W. F. S., *Bayfield, Wis.*—Please help me out in a matter that has given me considerable trouble. I put in a bathtub for a customer, and as they had no range for heating the water but a large No. 10 common cook stove I made a water back out of ¾-inch gas pipe, using five ¾ close return bends, and placed it in front of the heavy sectional cast iron fire back in the stove, the water back being the full size of the fire back. Since putting it in the oven will not bake at all on the top and, also, bakes very much slower on the bottom. They use coal exclusively the year round and have exceedingly hot fires, yet the oven will not bake. The stove always baked well before the water back was put in. The reason I placed the water heating apparatus at the back was: 1, They wanted all the hot water they could get; 2, by putting it in front it would interfere with the drafts of the stove, and, 3, I saw several different styles of ranges with water backs instead of fronts and thought if they baked all right this one should. I have heard that occasionally there is difficulty in ranges so constructed.

Note.—It is not unlikely our correspondent's difficulty is due to the fact that the water back takes out so much heat from the fire that not enough is left to bake suitably. We hardly think the trouble is due to its direct cooling influence on the oven. He intimates that a great deal of hot water is used in this house, and it is needless to point out that if this is so, a great part of the heat of combustion of the coal is carried off by the water, and consequently does not go to the oven. We can make no suggestions except to remove the water back or reduce its size and so locate it that it will not obstruct the flue and hinder the draft, or else increase the grate area.

From G. W. J., *Farmington, Ill.*—In answer to "W. F. S.," Bayfield, Wis., I would advise him never to try to use a coil water back or cast water back. Instead, let him use a coil water front made in the following manner: Run three pipes in front with close bends.

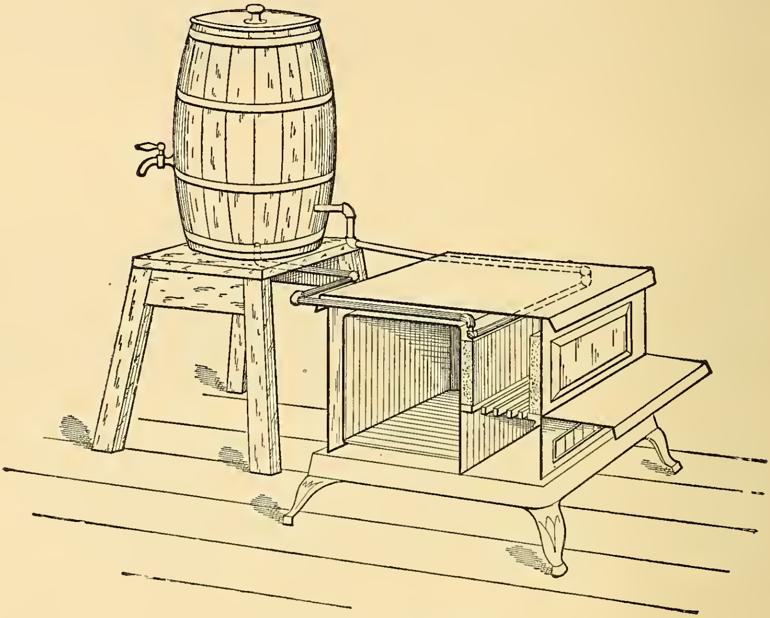
Then at the opposite ends of the fire box from the boiler run pipe across the end of fire box to center of long T center. Then turn to boiler, letting the pipe hug T center, to give the draft over the oven plate all the space possible between the pipe and plate. Also give gradual rise to all coil pipes. Three-quarter inch pipe is large enough for a 30-gallon boiler, though the size of the pipe depends upon how much room there is between the oven plate and T center. Good judgment is all that is required.

A PLAN FOR HEATING WATER.

From J. S., *Vincentown, N. J.*—I have a customer who wants plenty of hot water for dish washing at a country hotel, and does not want to interfere with the cooking. There is no water supply except from a pump, and his stove is an old fashioned flat top cook. He does not want to spend money for a new stove, a tank and a force pump, but thinks that a Yankee ought to be able to meet his case. So I make application to *The Metal Worker* for assistance.

Answer.—A supply of hot water that has been found satisfactory in similar cases has been obtained by the following plan, as shown by the cut : A pipe water back is made for the stove, special ells being used for the purpose. One pipe enters from the back of the stove, just above the top of the oven, and runs across it to the fire chamber, with a drop ell. Then along the fire chamber to another ell and from it across the oven on the other side and out of the stove. If the special drop ells cannot be secured readily, two more ells should be used to drop the pipe that runs across the fire chamber so that it will not choke the draft. The fire bricks should be cut down in hight, to let the pipe back so that it will not take up fire space. A stand should be made to support a good oak barrel a few inches above the top of the stove. From the bottom of the barrel a pipe should be taken that has been connected by asbestos washers, red lead and jam nuts. About 6 inches above the bottom of the barrel another pipe should be taken f om the side. These two pipes should now be connected with the pipes in the stove, being careful to have a slight descent from the bottom of the barrel to the fire chamber, and a slight ascent from the fire chamber back to the side of the barrel. The more direct connection should be made to the side of the barrel. A faucet should be placed about 10 inches above the bottom of the barrel s › that there will be no possibility of the

barrel becoming empty. The barrel can be filled by a bucket nearly to the top, leaving some space for the water to expand as it is heated. A wooden cover should be provided. If steam is made in



A Plan for Heating Water.

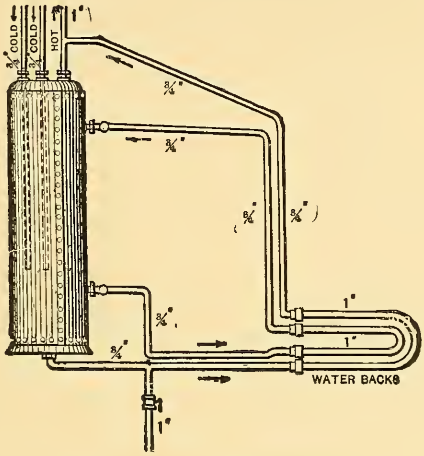
the kitchen a pipe can be run from the side of the barrel, near the top, to the chimney to carry the steam off.

A SUGGESTION IN WATER BACKS.

From A. H. F., *Lancaster, Pa.*—I am an apprentice and would like the readers of *The Metal Worker* to give me their opinion of this boiler and range connection, which I think would be a great advantage where the water back of a single range is not large enough, and where it is not desired to go to the expense of connecting two water backs to the boiler. The water front is made of 1-inch pipes. I think when put in as shown in the sketch they would not take up any more room than a cast water back and would give more hot water.

Note.—We have reproduced our correspondent's sketch, as it is

an interesting modification of the ordinary water back, but we fail to see that it has any special points of merit. The fact of the matter is, the heating power of the water back depends upon the surface it exposes to the fire, provided there be connections of suitable size between it and the range boiler. In the present instance a double coil, giving the surface of four lines of pipe, and then connected by



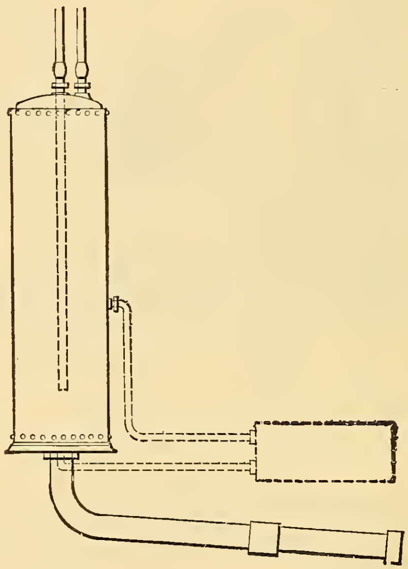
A Suggestion in Water Backs.

flow and returns of suitable capacity, would, we think, have fully as much heating power as the double arrangement shown.

A WATER BACK IS BETTER.

From G. M., *Camden, N. J.*—A friend of mine contends that better results can be secured from a kitchen boiler by running a pipe from the bottom of it to the fire and extending into it some 6 or 8 inches than can be secured with the usual water back connection. The illustration presented herewith shows his idea in the large pipe from the bottom of the boiler, which he claims must be of twice the capacity of the pipes ordinarily used to accomplish the results which he claims. The dotted lines to the boiler show the usual pipe connections to the water back. He claims the water will circulate through the single pipe the same as if connected in the regular manner, because hot water ascends and cold water descends. We have left the matter with *The Metal Worker* for a decision.

Answer.—The idea advanced is not new, and if the device possessed the merit which is claimed, the more expensive water back connections of to-day would have long since been supplanted by it. That circulation of water will take place in such a pipe is true, but in an irregular way. In operation the device would have a tendency to create steam, and there would be a continual struggle for the hot water to find an exit against the pressure of the cold water. The water in the extreme end when the fire was excessively hot



A Water Back is Better.

would be rapidly generated into steam, and the continual condensation and creation of vacuum to be filled by an inrush of water would be a severe strain on the piping, and create a noise that would be anything but pleasant.

HEATING CAPACITY OF WATER BACK.

From E. W. H., *Santa Barbara, Cal.*—I want to set a 50-gallon kitchen boiler, and should like to know how many feet of ¾-inch pipe should be exposed in the fire box to heat the water rapidly, using wood as a fuel. How

should the pipe coil be placed in the fire box? Is ¾-inch pipe the proper size to use? Is a pipe water back preferable to a cast iron one? Is anything gained in the rapidity of heating the water by placing the boiler horizontally above the top of the range? Should both of the pipes from the boiler pitch down to the water back? With a view of keeping the water hot after the fire had died down, and also of keeping down the temperature in the kitchen, would it pay to jacket the sides of a 50 gallon boiler; and if so, would a ½-inch layer of hair felt, covered with a layer of tin, be enough better than ¾-inch pine without a tin covering to warrant the added cost of the felt and tin?

Answer.—The capacity of the water back or coil for heating water used in connection with a kitchen boiler has not been recorded, and is a question which is open to solution. A method of calculating the capacity, which has been found satisfactory by a correspondent, decides that 1 square foot of heating surface in a pipe coil will successfully heat 5 gallons of water; and then the correspondent states that a very much larger quantity can be heated without risk. By another correspondent the statement is made that 1 square foot of heating surface will heat half as many gallons of water as it will carry feet of radiating surface in a radiator. It is generally assumed that a coil made of wrought iron pipe and located in the fire box is one of the best heating surfaces that can be obtained, from the fact that in a majority of cases all sides of the coil are affected to a greater or less extent by the direct action of the fire. When such a coil is used in a hot air furnace or heating stove it is calculated that 1 square foot of such coil surface will carry about 30 feet of surface in a radiator; and, using the deductions of the previous correspondent, it can readily be calculated that 1 square foot of heating surface in the coil will heat 15 gallons of water per hour from 60 degrees to 212. If our correspondent wishes to heat 50 gallons of water 3 or more feet of surface will be required; and if he desires to heat the water quickly he will find it better to use 1-inch pipe than smaller. After circulation is started between the water back and the boiler the water will enter the water back at a considerably higher temperature than 60 degrees, and will reduce the work to be performed by the water back. It is quite possible that 3 square feet of heating surface would prove sufficient to heat the quantity of water specified if exposed to a steady fire. If, however, water is to be drawn off from the boiler frequently, and the coals of the wood fire do not lie against the heating coil, it may be better to use a coil exposing much more surface From the information given in reference to the first question it will be seen that the pipe water back has more advantages

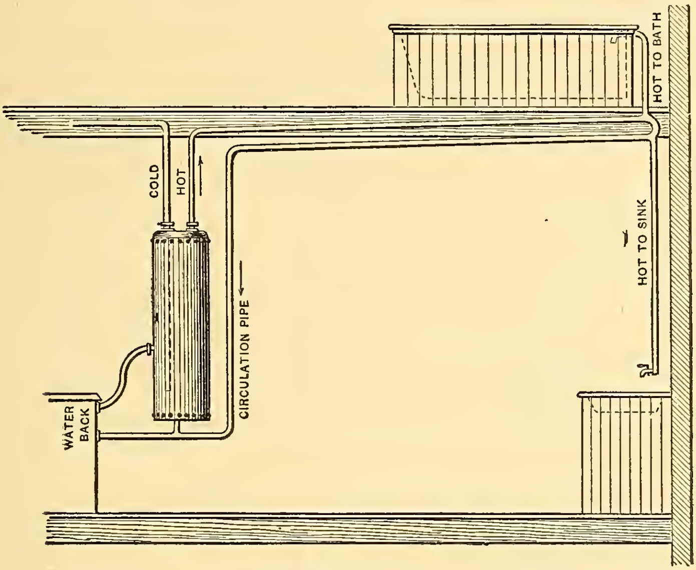
than a cast iron one, and its proper location is in the fire box. It has been stated by those who have had experience that a boiler placed horizontally above the range heats more quickly than it is possible to heat a boiler of the same size set upright beside it. It not only gets the radiant heat from the top of the stove, but also the heated currents of air arising from it; and a still greater advantage is derived from the more rapid circulation which will always take place between a boiler and a water back when the boiler is located a few feet above it. The pipe should run as straight and direct as possible from both of the connections at the boiler to the water back. There is no doubt of the benefit to be derived from covering the boiler to prevent the loss of heat both in summer and winter, but it is probable that small benefit, from a financial standpoint, would be derived from the use of a high priced boiler.

FIRE OVERTAXED.

From J. G., *Red Bank, N. J.*—I have a job piped with iron pipe, as shown in the sketch, in which it is impossible to get the water hotter than lukewarm. A ⅝-inch supply connects at the top of the boiler and a tube of copper runs within 6 inches of the bottom of the boiler. A ¾-inch hot water pipe runs from the top of the boiler to a sink and bathroom and then is reduced to a ⅝-inch pipe, which returns to the boiler and connects with the pipe which carries the cold water from the boiler to the water back. The cold water pipe to the water back and the return to the water back are both ¾-inch. All of the pipes have a heavy fall and the bathroom is on the second floor, all the other fixtures being on the first. The range used is a No. 8 hot air range with an oval cast iron fire pot, which is cut out on one side for the water back. If the water cannot be made hotter the job will not be satisfactory.

Note.—Evidently a great deal of work is required of the fire, which must cook on top of the range, bake in the oven, heat the kitchen and heat a current of cold air to be used in warming another room as well as heating the water in the boiler and the constantly cooling circulating system by means of the water back. The water back in such a range is necessarily exposed to the air current on one side, which has a cooling effect, and the fire chambers are not ordinarily increased to meet the extra requirements. The cast iron fire pot with the air currents outside of it absorb heat and chill the outer portion of the fire very rapidly and do not leave it in a state to have a powerful effect on the water back. It is probable that the water back is placed on the side away from which the gases are drawn, and they

have very little effect upon it, and, as a consequence, it fails to heat the water. It is probable that the result desired by our correspondent can be best obtained by doing away with the water back, using a solid fire pot in the range and running a coil of 1-inch pipe around the top of the fire pot. It should be run so that it will not obstruct



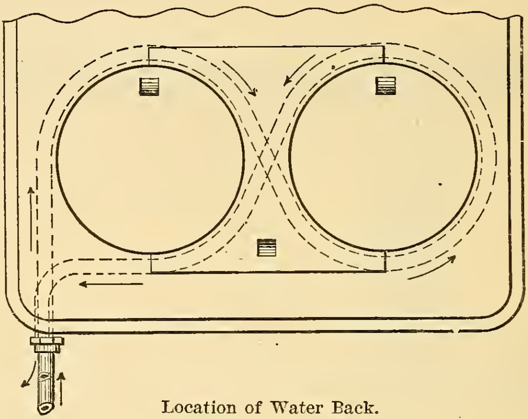
Fire Overtaxed.

the draft, yet will be subjected to the hot gases passing over it as well as being heated direct by the fire. There is nothing in the piping of the job to be criticised except that larger than a ½-inch return pipe is seldom used on so small a job, and often a ⅜-inch pipe is considered ample.

LOCATION OF WATER BACK.

From J. R., *Trenton*, *N. J.*—I submit herewith a sketch of a pipe water back which I have seen in a coal range when using gas as a fuel. It will be readily noticed that it exposes much more surface than is presented by the usual return bend coil, and that it is so constructed that there is a gradual ascent in the water way from the inlet to the outlet; also that it is so located with reference to the

cooking holes as to not interfere with the cooking. From my experience with heating coils I am inclined to believe that, located as this coil is, it will do better work than if it were in the fire chamber proper, where the coal comes in contact with it. This coil is intended to be suspended above the top of the fire so that the radiant heat and also the hot gases come directly in contact with it; and when used in



Location of Water Back.

a wood range I am of the opinion that its efficiency could not be improved by any other location. I am satisfied that a coil made in this style and located above the fire will heat 15 to 20 gallons for every square foot of surface exposed.

CHAPTER II.

BOILER CONSTRUCTION, OPERATION AND CONNECTIONS.

Originally water backs supplied the hot water direct through the pipes to the faucet, and to meet this demand on their capacity they were gradually enlarged to an unwieldy size. Their size shrunk again, however, on the introduction of the storage tank, the outgrowth of which is to-day commonly called the kitchen boiler. The boiler is generally made of heavy sheet iron and galvanized, or of copper and tinned on the inside. When made of iron the material is sufficiently heavy to prevent its collapsing in case of its being emptied of water. Copper boilers are reinforced on the inside by bands or rings to give them strength for the same purpose. Valves are sometimes placed at the tops of boilers, or pipes are run from the boilers to a point higher than the supply, with an open end to permit air to enter to prevent a vacuum and collapse of the boiler or to permit the escape of air or steam. Boilers are made to stand various pressures from the street mains without bursting, and are tested, as a rule, to 150 pounds to the square inch. In size boilers vary from 20 gallons to the popular 30 and 40 gallon sizes that are 12 and 14 inches in diameter and about 5 feet high, up to the 80 and 100 gallon sizes. Special boilers that hold 500 to 1000 gallons are made to meet the requirements of a large hot water supply.

Boilers are used both upright and horizontal, and in either case they always have four openings. The upright boiler has two openings in the top, one in the side about 18 inches from the bottom and one in the bottom. One of the top openings is to receive the water supply, and should have a delivery tube attached to it running down to a point half-way between the side opening and the bottom of the boiler. This supply tube should have a hole in it, just within the boiler, ⅛ inch in diameter, to prevent the water being syphoned out of the boiler in case the water supply should be shut off and water drawn from some lower faucet. The other opening in the top of the boiler

is for the hot water service. The opening in the bottom of the boiler is for a pipe to carry the water to the water back, and this pipe should have a cock in it to empty the boiler when repairs are necessary, and also to drain the boiler occasionally and let the sediment that collects at the bottom pass off. The opening at the side is usually about one-third of the hight of the boiler from the bottom, and is to receive the pipe that carries the hot water from the water back. In some sections of the country boilers are made with three openings in the top, the third opening having a delivery tube, the same as the cold water supply, and is used to receive the water from the return pipe of a circulating system. Boilers are constructed for special cases with a coil of pipe inside of them, through which steam is passed to heat the water. The boiler must be supplied with water from a source that will always keep it full, and if so supplied it may be set in a room above, in another room, or at any convenient place in the same room with the water back with which it is connected. When the boiler is located beside the stove a stand should be secured that is high enough for the purpose. It is probable that a majority of the boilers in use are set much lower than is desirable, though it is possible to secure circulation when the side opening in the boiler is only a few inches above the top of the water back.

Circulation is the movement of water between the water back and the boiler and is due to the difference in the weight or density of the water at different points, caused by its expansion by heat. The cooler water being the heavier sinks and forces up the hot water, which is lighter, and as the object is to get the coolest water to flow to the water back to be heated, it is evidently desirable to have the boiler set at a reasonable hight and preferably above the water back. As the water expands by heating, the return pipe from the water back should be larger than the pipe that supplies the water back, and it would also be well to have the boiler opening of a correspondingly large size. As soon as the heated water reaches the boiler it rises to the top, and losing some of its heat it falls. When the water back is made the low point the cold water passes to it and the hot water is forced to make room for it, keeping up a constant circulation. When all the water in the boiler has been made hot the action is the same and governed by the same influence, but the difference in temperature at the hottest and coldest points being so slight, there is little difference in weight to promote

circulation, and then it is not sufficient to overcome any defects in principle or piping. When the water is cold and the fire is first started, the difference in the temperature and weight of the water at the hot and cold points is greatest and circulation is free and smooth; but when all of the water becomes so hot that no difference can be felt in the water back pipes, the circulation almost ceases. Then a seemingly slight departure from the correct principles assumes proportions that cause great annoyances, for steam is liable to form in the water back, which, together with trapped pipes, badly wiped joints or protruding washers and small return pipes, all tend to produce the noise that is such a frequent cause of complaint. If the top outlet in the water back is below the top of the water chamber, opportunity is afforded for the collection of steam, which will stop or delay circulation until it rushes to the boiler, when it is liable to condense anywhere in transit, and the sudden filling with water of the space it occupied will be effected with a force that will strain and stretch the lead pipe and produce a thumping and rattling that sometimes can be heard wherever the piping extends. This force frequently bursts the hot water pipe when made of lead and sometimes bursts the water back.

PRESSURE SUPPLY AND PIPING TO BOILER.

From J. M. S., *Hinsdale, N. Y.*—I have a range boiler to set and would like *The Metal Worker* to answer the following questions and give the reason for them: Water is to be supplied to the boiler from a tank over the kitchen, and hot and cold water are to be supplied to a bathtub and wash basin and for use in the kitchen. I will have to run a pipe from tank to boiler. Would it be best to run this supply down into the cellar and tap it there to supply the tub and basin and then continue it up to boiler, or should I put in a separate pipe from the tank to supply them with water? Would there be sufficient pressure to keep the boiler full and supply the other fixtures with water if only one pipe is taken from the tank? Is it necessary to extend either the cold water inlet or the hot water discharge down into the boiler, and how far for each? The boiler is to be heated by a water back in a range, and ¾-inch pipe is to be used throughout. Is this correct for the different pipes?

Answer.—It is not necessary to have a separate pipe to supply the boiler with cold water, and a branch from the pipe that supplies the other fixtures will answer every requirement. Just as long as there is water in a tank placed above a boiler the water will run down into the boiler, though when a cock is opened on the same pipe the

pressure will be slightly reduced, but not enough to cause trouble. The cold water pipe should extend down by means of a tube into the boiler to within 6 inches of the bottom, and the tube should have a hole in it 1/8 inch in diameter at the top to prevent syphonage. This tube delivers the water to the boiler without permitting it to mingle with and cool the hot water at the top. The hot water discharge should not extend down into the boiler, because the hottest water is at the top and should be allowed to escape at once. There will be no trouble from the use of 3/4-inch pipe, though 5/8-inch is more generally used for economy both of water and material, as it supplies water fast enough to be satisfactory for household use.

CONNECTING SUPPLY PIPE TO RANGE BOILER.

From C. W., *Norfolk, Neb.*—What objection is there to connecting the supply pipe of a range boiler outside to the bottom of the boiler, instead of at the top and running it down inside to near the bottom, as is the usual way? It seems to me that one would be as efficient as the other.

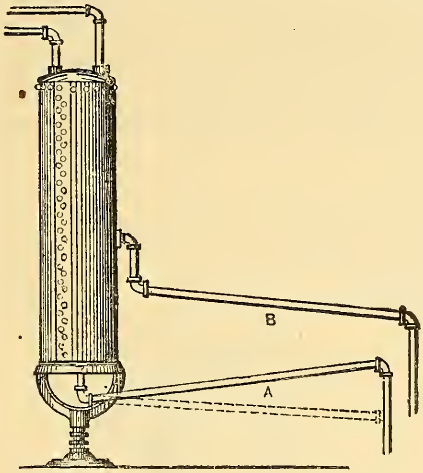
Answer.—So far as the efficiency is concerned there is no choice between the two methods. If our correspondent particularly desires to bring his cold water pipe to the bottom of the boiler on the outside, we really can see no serious objection to his doing so. The only thing to bear in mind is that if the cold water supply is not carried to the level of the top of the boiler, any interruption in the supply by opening a faucet below the level would empty the boiler completely, and this is a situation most people try to guard against. Furthermore, if the supply was run to the level of the top of the boiler and then immediately down to the bottom, there would be some danger of syphoning the boiler empty if the water was drawn from a lower level. Where the cold water supply enters through the top of the boiler a small hole near the connection prevents this syphoning, but it would hardly be feasible to have the hole in the pipe if the latter was without the boiler.

FAULTY CIRCULATION IN RANGE BOILER.

From E. M., *Potsdam, N. Y.*—I send herewith the drawing of a range boiler which I have set and which does not do good work. I have set a good many in the same way and I have never had any trouble before. The water

front in the stove is tapped for ¾-inch pipe and the boiler piped with ¾-inch galvanized pipe, with ½-inch pipe inside. I would like to know what was the cause of the faulty circulation.

Answer.—If our correspondent's sketch represents the exact position of the pipes, we think the cause of the trouble is easily discovered. The pipe A which carries the cold water from the boiler to the water back is made to rise from the bottom of the



Faulty Circulation in Range Boiler.

boiler to the elbow, from where it descends to the water back. This arrangement is a most effectual way of checking circulation, as the water is forced contrary to the natural direction of the flow. If our correspondent will raise the boiler so that both of the pipes A and B incline up from the water back and form a continuous ascent to the boiler we think he will have no more trouble. Another way of accomplishing the same end would be to run the pipe A as shown by the dotted line.

TROUBLE FROM SMALL PIPING.

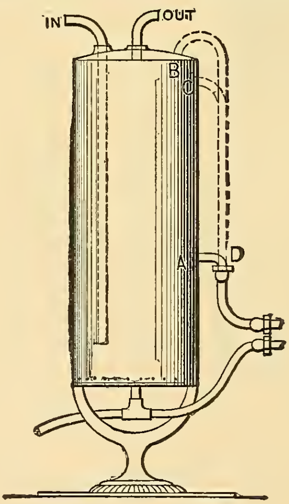
From G. C. P., *New York.*—I would like a little more information about a hot water boiler. I was called upon to fix a boiler in which the water keeps up a continuous boiling when the fire is lighted. It annoys the family very much and they want it stopped without putting out the fire. There is a ½-inch lead pipe connected to the fire back.

Note.—We can safely say in the present case it was a mistake to connect the fire back to the range boiler by so small a pipe as ½.

inch, for the larger the circulating pipes the freer would be the circulation and the less opportunity exist for steam to form. Furthermore, where the water is limey, a circulating pipe will often block up quickly, and there is all the more reason for a pipe of ample size to begin with. Another common trouble with range boilers is to have too large a surface of water back, which raises the temperature of the water in the boiler so high that the least addition of fire will produce ebullition. Any traps in the pipe will interfere with the circulation and sometimes give rise to the noise complained of, and it is possible that the small area of the ½-inch pipe may so impede the circulation that steam forms in the water back before the water in the boiler is brought to the temperature of boiling. The entrance of this steam to the boiler and its sudden condensation there creates the noise.

CONNECTED TO HEAT RAPIDLY.

From C. C., *Chicago, Ill.*—How could I improve the efficiency of a 50-gallon hot water boiler so as to facilitate the rapid heating of at least a por-



Connected to Heat Rapidly.

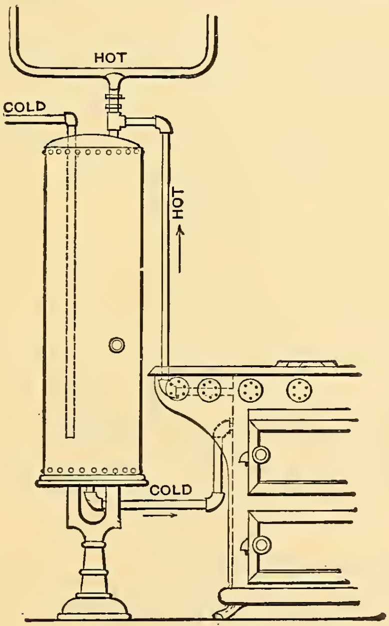
tion of, if not the entire, water contained in it? My case is this: A customer of mine recently moved into a house, in the kitchen of which a 50-gallon boiler is set up and connected with the usual hot water piping found in most houses to sink, bath, &c. The tenant who lived in the house before, and whose range I also connected to the same boiler, had no difficulty in getting all the hot water he required. He, however, had a large No. 9 range, with a large water

back. The range of the new tenant is somewhat smaller, and in my opinion should be considerably larger to perform the task required of it. He does not care to buy a larger range, but wants me to fix the matter so as to help him out if possible. To do this, I propose to change the hot water return from the range from where it enters the boiler now at A to where it is shown at B by the dotted outline of the pipe and stop up the hole at A. This arrangement I think will do the business; am I correct? I would like to have your opinion on this proposed change in the pipe.

Answer.—The expedient suggested by our correspondent will help him out of the difficulty. It would be a better plan to connect the inlet at the point C instead of at B, say 6 inches or 8 inches below the top of the boiler. This plan of putting the hot water connection at the top of a boiler in order to obtain hot water quickly does good service.

QUICK HEATING CONNECTIONS.

From MILWAUKEE GAS STOVE COMPANY, *Milwaukee, Wis.*—We have before us your answer to "C. C.," and knowing that you are open to

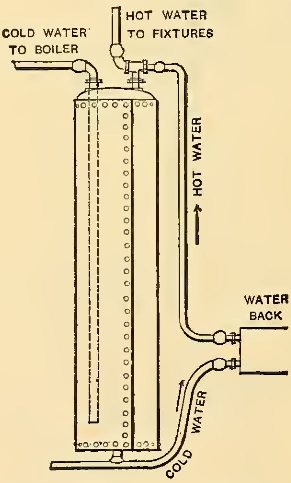


Quick Heating Connections.

information we give you some based on actual and exact experiments. We have met with the same complaint as your corre-

spondent in adapting gas to the work of heating water, and about three years ago hit upon the plan illustrated in the accompanying cut, being, so far as we know, the originators of this method. The experiments were made with a 40-gallon tank, first with the ordinary side and then with the top connection. Comparative tests were made for 10, 20, 30, 60 and 90 minutes, all conditions being the same for each. The temperature of the water was taken before each trial and at the end of the specified number of minutes the entire 40 gallons were drawn off into a bathtub and the mean temperature recorded. In every instance the top connection showed the better result. That we obtained a higher mean temperature was a surprise to us, and we can only account for it by the fact of the heated area being less, and the radiation thus proportionately decreased. However, the fact remains as stated, and should these tests be doubted we respectfully advise that they be repeated by others and the result, we are sure, would be that never again, under any circumstances, would the "good (?) old way" be advocated.

From N. S. P., *New York.*—I quite agree with the conclusions in your reply to "C. C." as to the connection of the return (hot water)



Quick Heating Connections.

pipe from water back, because of personal experience in that direction, which agrees with that of the Milwaukee Gas Stove Company. At the same time I must dispute the correctness of the claim pre-

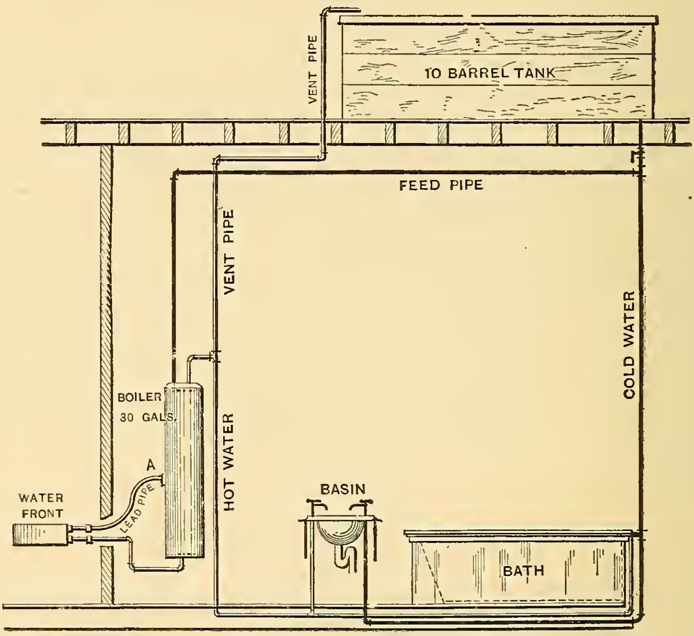
sented by the last named company, that the idea of connecting the hot water return pipe at top of boiler originated with them three years ago, because I have been experiencing the benefits of that method of connection for more than ten years. When I purchased my house about that time the boiler was in position, but failed to give satisfaction, as no hot water could be drawn from it for a considerable time after the fire would be lighted in the morning. My plumber, who is well known as one of the leading members of the Master Plumbers' Association, at once undertook to remove the cause of dissatisfaction, and made changes which were certainly new to me. He took out the hot water return pipe from the usual side opening in boiler, which he had plugged up, and carried the pipe upward to top of boiler, where he had inserted a T, to one branch of which he connected it. From the other branch of the T he took his hot water supply pipe for the fixtures through the house, and I can state positively that since he made the change there has not been a particle of trouble with the hot water supply. He does not claim originality for his method, as it was well known at the time as the Creque method of connection. He maintains, however, that the water in the boiler will heat more rapidly by having the hot water return pipe connected at top instead of side of boiler, and as he has given me satisfactory proof that he is correct, it is only right that I should concur in his opinion. I inclose diagram of boiler connection.

A NOISY RANGE BOILER.

From F H. & N., *Dundee, N. Y.*—We address you for information on water heating arrangement, as shown in the accompanying diagram. The trouble is that there is a rumbling and snapping at A in the return pipe from boiler to water front. We first had ¾-inch iron pipe where the 1-inch lead pipe now is. We think the 1-inch lead pipe helps the trouble a little, but still it rumbles and snaps continually. We have examined every pipe about the boiler and water front to see that none were screwed in too far. We would place the boiler further away from the range, but cannot do so, as there is no place to put it in.

Note.—As our correspondents' sketch shows, there is apparently no trouble with the pipe. It would, however, be better for the cold water pipe between the water front and boiler to run on an easy curve, instead of the sharp bend shown in the sketch. It is possible that this construction, due to the sharp bends, may retard the water

sufficiently to permit the formation of steam, and that being expelled from the water front and condensing as it meets the cold water in the boiler, gives rise to the rumbling and cracking noise complained of. We would suggest that while this may increase the trouble, not unlikely the real cause is the too large exposure of the water front to the fire. Our correspondents might try the experiment of cutting off some of the water front by means of fire brick placed in



A Noisy Range Boiler.

front of it. There would be no particular advantage in placing the boiler further away from the water front; the only difference would be that there would be the chance of radiation from the connecting pipes, but this would not have any appreciable effect.

From W. N. N., *Washington, D. C.*—I notice a description of a noisy range boiler, by "F. H. & N.," Dundee, N. Y. If your correspondents will change their boiler connections, as shown in Fig. 1 of

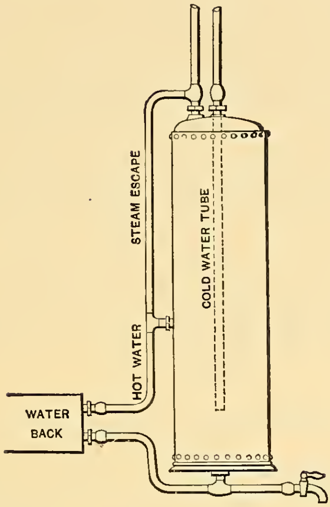


Fig. 1.—Remedy for Noisy Range Boiler.

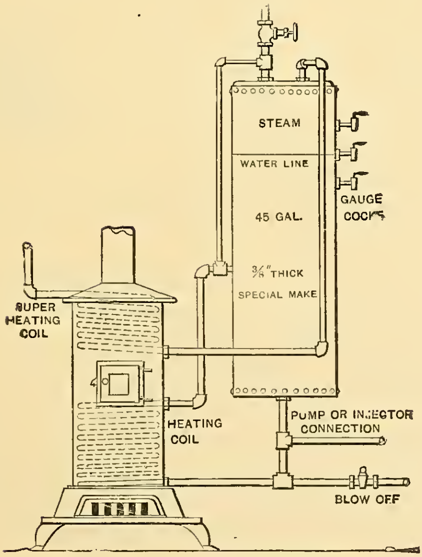


Fig. 2.—Ryan's Steam Apparatus.

the sketches I send, I will guarantee that the boiler will be as gentle as a lamb. This connection was patented by John C. Ryan of Chicago about 1867, for a steam heating apparatus, and it is also a good arrangement for heating and small steam plants, it being sufficient to run a 6 horse-power engine in a brass foundry. I am certain the patent has run out. The connection as originally applied is shown in Fig. 2. Where used for supplying steam to an engine the steam was taken from the top of the supplementary boiler and passed through a coil over the fire before being taken to the engine. If only used for steam heating this supplementary coil is not employed, the steam being taken direct from the top of the reservoir boiler. The lower coil contains 75 feet of 1-inch welded pipe.

PIPE THE SAME AS IN HOT WATER HEATING.

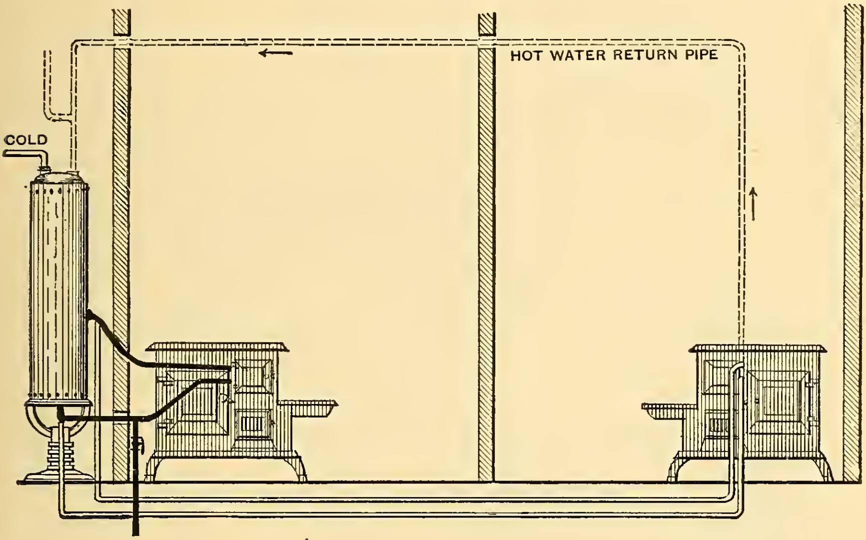
From S. H. D., *Watkins, N. Y.*—I notice a good many suggestions in *The Metal Worker* as to the proper manner of making range boiler connections. Allow me to say that if a boiler is treated the same as a hot water radiator and the connections made in accordance with the rules for hot water heating, the boiler can be placed anywhere in a building that a radiator could be placed with good results. The circulating pipe must be kept separate from the supply and distributing pipes. I have placed boilers in many strange and unusual positions and have never failed in a practice covering many years to get good circulation.

PIPING FROM STOVE TO BOILER IN DIFFERENT ROOM.

From T. V. L., *Holland, Mich.*—One of my customers has a kitchen boiler and stove, with heating coil, set up in the usual position, with flow and return pipes fixed in orthodox fashion. The boiler stands in bathroom, which is separated from stove by a partition, but the water is heated and circulates satisfactorily. The owner, however, desires turning the room in which the stove stands to some other purpose, and contemplates moving the stove into another room 24 feet away from the range boiler. The difficulty is in providing for the hot water circulation pipe, which it is suggested should be brought down from water back and carried, together with the cold water supply pipe, under the floor for 24 feet, and then connected in the usual way at side opening in boiler. I do not think it will work satisfactorily; but as the owner desires the job, of which I inclose a sketch, done in that way, I would like an opinion from *The Metal Worker*.

Answer.—The sketch submitted by our correspondent, as indicating the proposed change, shows the pipes carried under the floor

from boiler to stove and return. Such an arrangement would be defective as regards the hot water return pipe, which would be trapped, and would not work satisfactorily, while the cold water may be carried under the floor, as shown. The better plan, as regards the hot water pipe, would be to carry it upward and across the intervening space along the ceiling, finally connecting it at top of boiler. By this means a proper circulation will be established, and no trapping of the hot water pipe occurs, such as would be the case



Piping from Stove to Boiler in Different Room.

if run under the floor. The natural tendency of water when heated is to rise, and if this action is reversed, trouble, dissatisfaction and failure to accomplish the desired result will necessarily follow. The diagram which we herewith present gives an intelligent view of the situation. The solid lines show the present or existing method, the stove and boiler in close proximity to each other, and the flow and return pipes discharging their functions properly. The double lines illustrate the hot and cold water pipe arrangement, with the stove removed 24 feet from boiler, as desired by the owner of the building. The dotted lines show the direction which we suggest as the proper one for the hot water pipe. viz., carried upward

from water back and across the ceilings intervening and connecting at top of boiler.

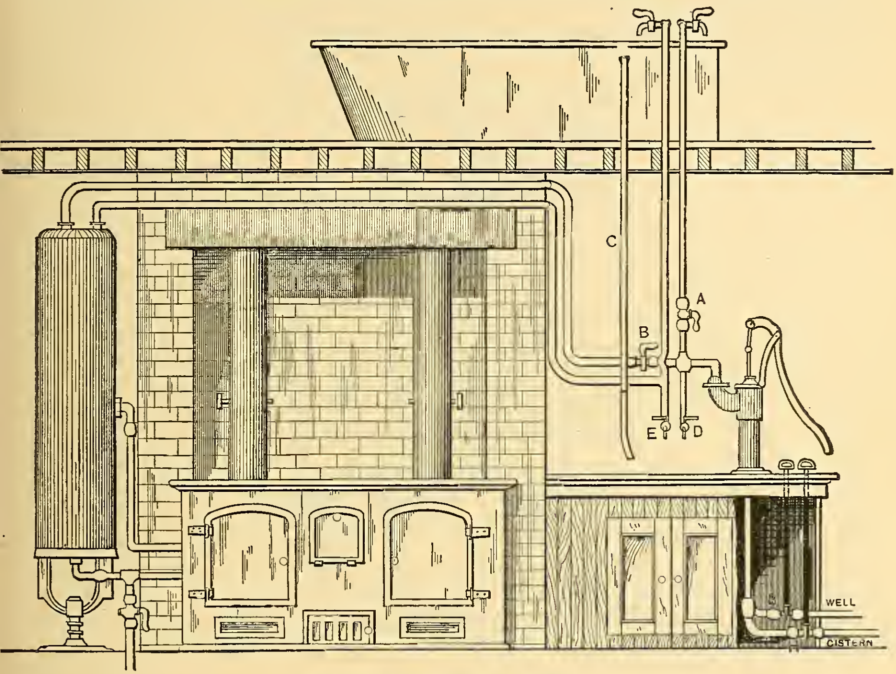
KITCHEN BOILER WITHOUT TANK.

From J. C., *Clinton, N. Y.*—I would like to know if there is any way that I can use a hot water boiler in the kitchen and not have a tank to feed the boiler. What I want to know is whether I can set the boiler high enough to draw hot water in the sink and feed the boiler from a force pump in the sink.

Note.—The circulation in a kitchen boiler for supplying hot water depends upon the boiler being constantly filled, so that the water will circulate through the water back and keep up a constant current through the reservoir. We do not think it is practicable for our correspondent to attempt to use a closed hot water boiler where the only source of supply is a pump attached directly to it. We would suggest that instead he dispense with the ordinary kitchen boiler and use in its place an open tank with a pipe from the bottom connecting to the lower pa t of the wa'er back and another pipe entering some distance up its side, so that when the tank is filled and a fire is in the range or stove a constant circulation of water will take place. Of course it will be necessary to keep the tank filled at all times, and there is the grave danger, where a pump is depended upon, that the water will be drawn off and the need of supplying the tank from the pump will be overlooked. In an extreme case the water might be drawn entirely from the tank and what was left in the water back expelled by evaporation and the water back become red hot. In that case the introduction of a supply of fresh water to the tank would likely give rise to a disastrous explosion. One safeguard would be to have a water glass at the side of the tank, so that the water level could be easily seen ; but even then, in an ordinary household, there would be a good deal of danger that the tank would not be kept properly filled.

From O M. H.—I saw a letter from "J. C.," in which he wants to know how to run a boiler without a tank. Now, several years ago, more or less, a party called on the Old Man to see if he could get them up a boiler that would pump well water, cistern water, hot water and cold water. It kind of knocked the Old Man silly at first, but after he had studied it he said he could do it ; and when he

said he could do a thing you could bet all you were worth he knew what he was talking about. I send you a sketch of the job he turned out, which worked first rate and gave perfect satisfaction. The sketch explains itself ; but as you may not understand it, I will give a little explanation. To pump cistern water in the sink close S, B and A and open H and D. To pump well water close H and open S. To pump hot water in the sink close S, D and A and open H, B

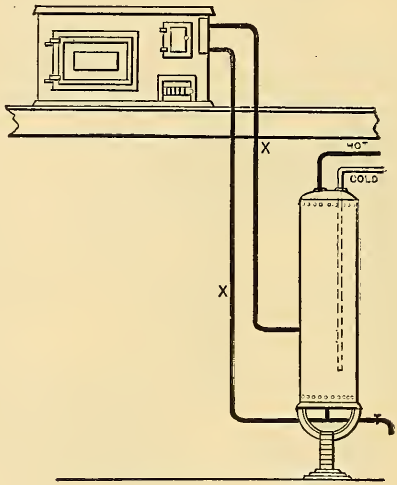


Kitchen Boiler Without Tank.

and E. To pump hot water in the bathtub close E, D and A and open B. To pump cold water in the bathtub close B and D and open A. The pump is an ordinary force pump. The boiler always remains full of water and would not collapse even if there was no water in it, as the hot water pipe can be left open all the time. Furthermore, there is no stop in the hot water pipe to the bathtub. C is a telltale pipe, showing the quantity of water, the depth and also the temperature. I send this sketch and account of the job, thinking that " J. C." or others may get some aid from i..

KITCHEN BOILER BELOW RANGE.

From P. S. J , *Jersey City, N. J.*—I submit a sketch of a boiler connection which I have made at the earnest solicitation of one of my customers and against my best judgment. The range is a brick set range in the kitchen and the boiler is located in the basement underneath, so that there is a space of about 18 inches between the top of the boiler and the bottom of the water back. After the connection had been completed and the range fired, heat could be detected in the pipe connecting in the side of the boiler as far down as X, and,

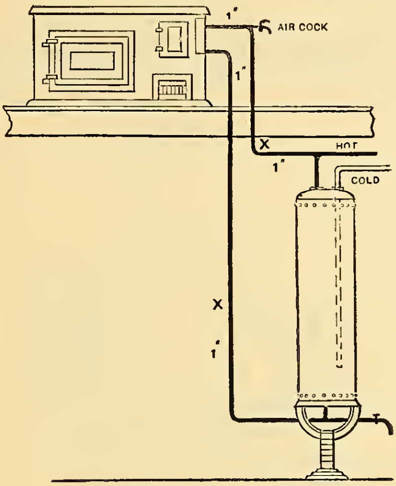


Kitchen Boiler Below Range.

strange to say, the pipe running to the bottom of the boiler shows heat at a point a couple of feet below this, as shown by the lower X. I have talked with a number of plumbers about this connection and am told that such connections have worked, while others claim that they will not work. I should be glad to hear from the readers of *The Metal Worker* if it is possible to get a circulation between the boiler and the water back and what must be done to secure it. Owing to the arrangement of the house there is no available place in the kitchen for the boiler, and it is not desired to put the boiler in the room above the kitchen. I think that there must be some way of

making this arrangement work and shall be glad to have the plumbing readers give their experience with jobs of a similar character.

From F. S. M., *Pawlings, N. Y.*—If "P. S. J." will run his pipes according to the plan herewith submitted I think his trouble will be at an end. If the water front is not already tapped for 1-inch pipe he should have it tapped for that size pipe, and run the flow and re-



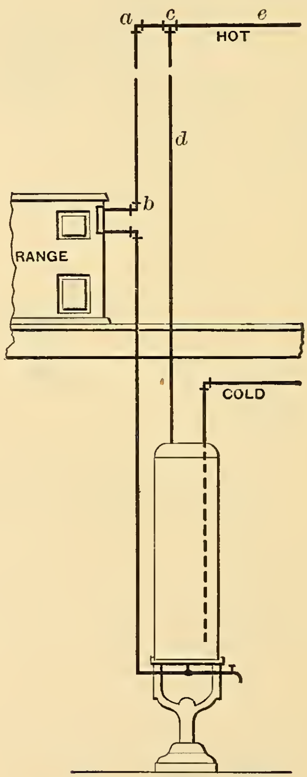
Kitchen Boiler Below Range.

turn pipes full 1 inch in size from the water front to the boiler. An air cock should be put on the highest point on the flow pipe, or, better still, a ¾-inch bib may be used instead, which will serve the purpose of the air cock and also furnish hot water as soon as the water front is heated. This is a job which is "agin' natur'," but if it is piped according to the plans good results will be obtained.

From G. F. S., *Washington. D. C.*—If "P. S. J." will put a T at the side connection to the boiler and will place a draw off cock at the side of the T he can start circulation by opening the cock and letting the hot hot water run down this pipe until it reaches the boiler, when the cock should be closed. After a circulation is started in this way it will continue as long as there is fire in the range. Every time that

the fire is drawn the same method of starting the circulation would have to be followed. Another method of securing circulation in the right direction would be to place a check valve near the water back on the pipe which leads from the water back to the bottom of the boiler. There should be a pet cock placed on the pipe from the water back to the side of the boiler at the point where it turns down. This should be opened occasionally to let the air which would naturally accumulate in it escape.

From W. R. G., *Augusta, Maine.*—The sketch herewith will show how such an arrangement as "P. S. J." describes can be made to work.

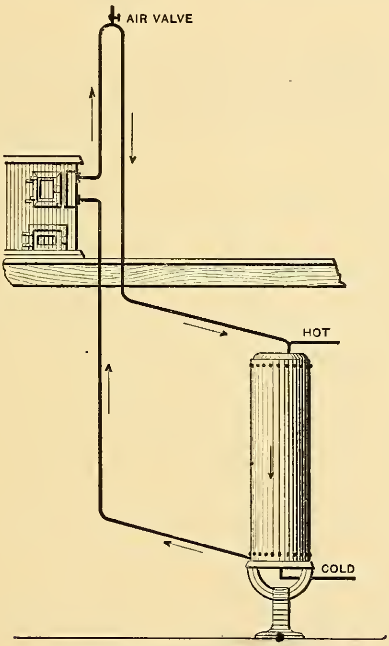


Kitchen Boiler Below Range.

The hot water pipe, leaving the range, is carried 5 or 6 feet above it and then is carried directly down to top of boiler, the other connec-

tions remaining about the same as shown on "P. S. J.'s" sketch. It will improve the working of the job if the pipe which supplies the fixtures with hot water is taken off, as shown on sketch, through pipe marked *e*, but it is not necessary to do so, as the hot water pipe may be taken from pipe *d* anywhere from fitting *c* to top of boiler. If it is taken from pipe *d* it will be necessary to run a vent pipe from ell marked *a* to the tank which supplies the system. If that is not done the air will gather and prevent the water from circulating.

From W. T. I., *Warren, Ohio.*—In answer to "P. S. J.," who asks for a plan to cause a circulation of water through a range and water



Kitchen Boiler Below Range.

tank, I submit herewith a sketch which will show how to produce the desired result. The pipe which is connected to the upper opening in the water back should extend toward the ceiling above the top of the range about 4 feet or more, if there is room, and then connect to a return bend, and at the highest part of the return bend put in an

air valve, to let out the air that will accumulate in the pipes and prevent them from becoming air bound. As the water becomes heated it rises, and the pipe toward the ceiling enables it to continue rising until it reaches the return bend, when it begins to cool and fall, and if there are no traps it will continue to fall till it reaches the bottom of the boiler. The cooler water goes in at the lower opening of the water back because the hot water has gone out at the top and the circulation is complete. Care must be taken to avoid all dead levels within the circuit. This is simply like a case in hot water house heating where the radiator is situated below the fire box. A similar arrangement of piping that we have in our house gives excellent satisfaction.

From SIPHON, *Newark, N. J.*—I would advise "P. S. J." to find some place in the kitchen for the boiler. It is unreasonable to expect a plumber to supply hot water to a building unless he has a fair chance. It is unnatural for water to circulate freely through such a system as he has shown, and if a circulation can be started it will not be that free, frictionless circulation which will be inexpensive and satisfactory. As he requires help, however, I will make the suggestion that he disconnect the pipe from the side of the boiler and put a plug in the opening. The hot water pipe from the water back should turn upward, so that it will run to the ceiling of the kitchen, where it should turn down and run to the boiler, connecting it at the top of the hot service. This method of piping will enable the hot water in the water back to escape to a higher point when it has become hot and make room for the water to flow into the water back from the boiler and thus start a circulation. If he desires a good circulation he should have a large water back and at least a 1-inch pipe and small boiler. The 1-inch pipe should be connected straight to the boiler, the hot water service pipe being taken from a T in the pipe. This method of piping is used often in hot water fitting when a stack of indirect radiation is located at some distance from the boiler and almost on a level with the top of it. In hot water heating an air valve is placed at the top of a siphon, but if any considerable pressure of water is carried on the system the air will be carried out of the siphon when hot water is drawn. In order to prevent the siphon becoming air bound it will be best to place an air valve at the top of it. If the siphon reaching

to the ceiling does not secure the circulation it may be necessary to run it up higher. A rule for calculating the siphon hight is to provide twice the head above the boiler of the drop to the fixture below it. Another method of piping would be to run the hot water service pipe from the boiler up along the side of the range to supply the second floor. Then the flow pipe from the water back may be connected into this pipe, avoiding the necessity of an air valve. The pipe from the water back to the boiler should be 1 inch in size, but the hot service pipe may be reduced to ⅝ inch, or the size of the other service pipes, after leaving the water back branch. The theory of the circulation in cases of this kind is that as the water in the pipe from the water back becomes cool from exposure it has no tendency to ascend, but rather to fall to the boiler, when the water rises in the other pipe to the water back and circulation is started. Such rapid circulation can never result, however, as when the water back is made the lowest point in the system, so that the cooler water will continually fall to it, forcing the hot water to rise.

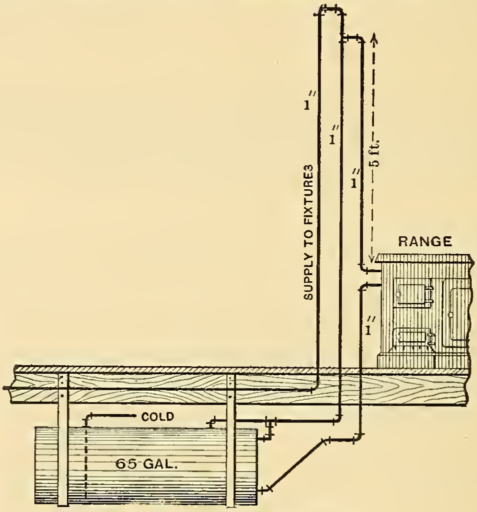
CHECK VALVE ON BOILER SUPPLY.

From R. S. J., *Hoboken. N. J.*—I notice in one of the answers to "P. S. J." a check valve on the cold water supply to the boiler is recommended. An expansion pipe from the top of the boiler, with a safety valve attached, is also recommended. In the first place, I see no benefit that could possibly be derived from such an attachment to aid in securing circulation. In the second place, I can see an element of danger and a possibility of damage in the use of a check valve on the boiler supply. If the system was filled with water and there was no fire in the range a considerable expansion would take place in the water in the system when it became hot. His expansion pipe and safety valve will take care of this expansion when they work ; but it is not an uncommon thing for a safety valve to fail to open at the right time, and then a pressure would be exerted on the boiler, water back, piping and faucets, due to the expansion of the water, that would force something to give way, and in all probability the water back would burst. If the check valve is used at all it would be needed to prevent water from running out of the system or being siphoned out in case the water pressure in the street main should fail to rise and supply the boiler. If it is placed to prevent hot water from backing into the main a small notch may be filed in

the edge of the check valve or a small hole drilled through it. This would prevent any considerable amount of hot water escaping to the main, and would avoid the expense of the safety valve and expansion pipe, as the expansion would find vent through the notch or hole.

BOILER IN CELLAR BELOW RANGE.

From H. E. B., *Berlin, N. H.*—A short time ago I had occasion to place a range boiler in a basement directly under the range in the kitchen in which the water back was placed. Never having seen a boiler placed below the range I did not think it would work, and informed my customer to that effect. I was told that if it did not work it could be changed; so I put it in as shown in the



Boiler in Cellar Below Range.

sketch herewith. It circulates fairly well and does not pound; but it makes very little difference which way it circulates, flowing down through the lower pipe and returning through the top one, and *vice versa*, thus keeping the water in the bottom of the boiler as warm as it does that in the top. It is a 65-gallon galvanized iron horizontal boiler, working under about 40 pounds pressure. Is there a different way to pipe the job to give better results?

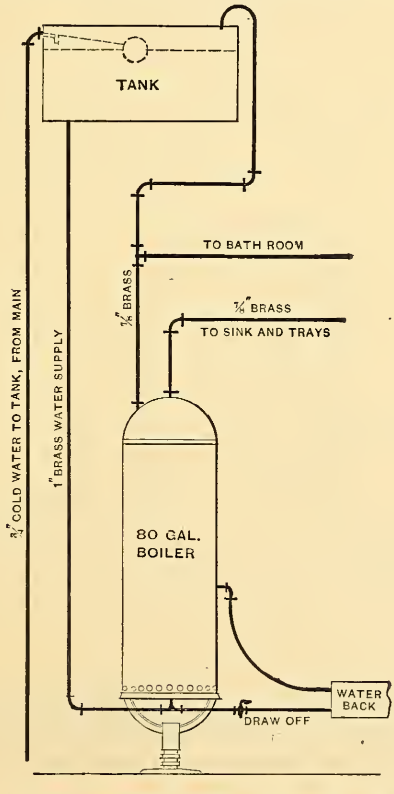
Note.—By piping as shown the supply pipe to the fixtures serves as an air vent to the circulating pipes between the range and the boiler. This system of piping also has the effect of reversing the natural order of circulation when hot water is drawn from the boiler, inasmuch as it makes an upward current in the pipe that should carry the hot water from the water back to the boiler and stops natural circulation. This then starts the hot water from the water back

down the lower pipe to the boiler, and after closing the faucet on the hot water service pipe the reverse circulation still continues. If the water in the boiler is satisfactorily heated no objection should be made to the reverse circulation. If the service pipe was connected directly at the boiler, independent of the pipes between the water back and the boiler, the opening of a faucet on the service pipe would not interfere with the circulation established between the range and the boiler. It is quite probable, however, that air could collect at the top of the siphon and would necessitate the use of an air valve.

IS THIS METHOD OF BOILER SUPPLY OBJECTIONABLE?

From F. C., *Natick, Mass.*—We would like to know if there is any objection to connecting the water supply to a boiler by means of a tank, as shown in the accompanying illustration.

Note.—It has been customary to deliver the cold water supply

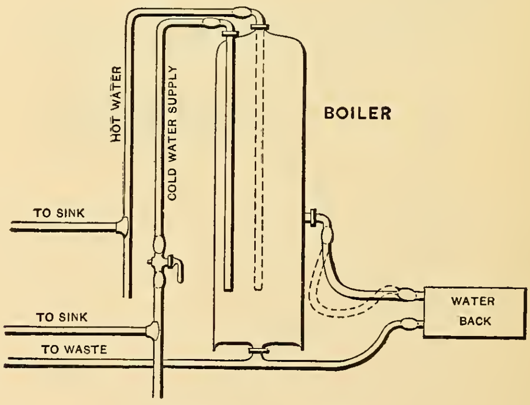


Is this Method of Boiler Supply Objectionable?

to the boiler at the bottom by means of a tube connecting with the top of the boiler and running down inside of it. This tube has been provided with a small hole near the top to prevent siphonage. This question has previously been discussed in *The Metal Worker*, and ordinarily the supply tank has not been a feature of it. Instead, the supply pipe has been run upon the outside to a point level with the top of the boiler, and then a turn has been made down to the bottom of the boiler where the connection was made. This arrangement of the piping was to prevent the water from running out of the boiler in case of a leak in the service or a failure of the water supply in the city main. But such an arrangement of piping did not entirely overcome the liability of siphonage. In the connection, as shown in the illustration, any possibility of siphonage is overcome by means of the supply tank. The tank must be placed at a point high enough to supply all the fixtures. The water will run rather slow from those faucets which are nearly at the tank level.

WHY WATER DID NOT HEAT.

From F. B., *New York City.*—I submit herewith a sketch of a boiler and its connection which I found, and which did not work satisfactorily. I am a



Why Water Did Not Heat.

young man and send this in to show how little some people care about their work, and hope that you will present it in *The Metal Worker* to show workmen the mistakes. The dotted lines show the arrangement of the piping as it was found, and also the location of the delivery tube in the boiler. The solid lines

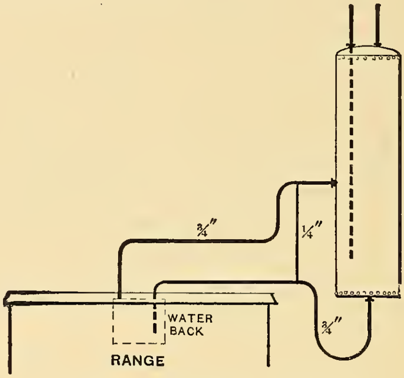
show how the job is connected at the present time, and I am pleased to say that it works satisfactorily.

Note.—We are glad to hear from any young man who takes an interest in doing work in a proper manner. The job as found shows the delivery tube connected with the hot water service pipe at center of the boiler and the cold water supply connected at the top; consequently, unless all the water in the boiler was hot there would be no likelihood of hot water being drawn from the boiler, and even under such conditions it would be possible for the cold water to make a short circuit direct to the delivery tube and out. It is not strange that the service was unsatisfactory. The delivery tube should always be connected with the opening to the boiler that is nearest to the outside. The piping in the water back, as shown by the dotted line, had a very effective trap in it which would seriously interfere with circulation. It is well to provide enough extra length in the pipe to allow for a free expansion and contraction, but there should not be such a quantity as to permit the pipe to sag and form a trap. Our correspondent has done the right thing in connecting the pipe so as to avoid a trap.

A REMEDY FOR TRAPPED CIRCULATION.

From D. E., *New York.*—There is not so much heard about trapped circulation in the plumbing trade at the present time as there was a few year ago. Some of the young readers of *The Metal Worker* may never have come in contact with plumbing systems where this condition was found. The accompanying sketch will show, therefore, to what extent the circulation of water was trapped in some of the systems of earlier times. The water back in the range was tapped in the top for the pipe connections, and in order that the cold water entering the water back would not interfere with the hot water in it a pipe was carried down inside the water back to a point near the bottom. Then as now the bottom of the boiler was frequently below the top of the range, so that the pipe bringing the cold water from the boiler had to make a considerable rise to reach it. The pipe carrying the hot water from the water back to the side connection of the boiler was usually free from trap, but it will readily be seen that the cold water pipe has a trap of several inches. In filling the boiler and water back there was a strong probability of a collection of air in the lower pipe. Even

should the system be filled without air accumulating in this pipe, it is a well known fact that all water contains more or less air, and that in the heating process the tendency is to liberate the air which collects at some high point. It is pointed out that when boilers of a given size were used in connection with the usual size pipe and the regular water back, very little difficulty was experienced with noise and with the circulation ; but when much larger boilers were used it was necessary to have a larger water back capacity. As no larger pipes were



A Remedy for Trapped Circulation.

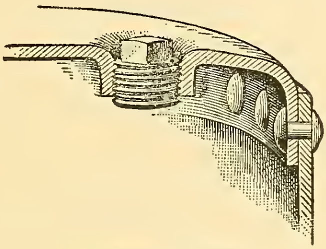
used the accumulation of air was greater and the water was made hotter, so the circulation became noisy and not always continuous, causing severe complaint where such apparatus was used. A simple remedy, which was applied in a number of cases, is shown by the diagram. It was a ¼-inch pipe used for connecting the lower pipe with the upper pipe so that the air could find outlet to the boiler and through the hot service pipes to the faucets.

LUKEWARM WATER.

From J. R. F., *Southington, Conn.*—I have had trouble with a boiler furnishing water that was only lukewarm and found it to be due to impeded circulation in the pipes. I took the boiler down and found the bottom pipe full of sediment, as if the boiler had been in use a number of years. I thought it was possible that the tube which connects with the cold water supply inside of the boiler had rusted off and dropped out of place, so the cold water mingled with the hot, which I have found a frequent cause of trouble.

MENDING A BOILER.

From H. J., *Camden, N. J.*—About four o'clock in the morning of the day before Christmas I was called to the house of one of my clients whose kitchen was nicely flooded with water. I immediately turned off the water in the cellar and found a hole in the top of the boiler from which water had been spurting until it had washed the paper off the ceiling for a space 3 feet square. The head of the boiler was of wrought iron, stamped up into a dome shape. I reamed out the hole almost large enough to receive a ¼-inch tap. Then with a tapering punch or drift pin, which I drove into the hole, I enlarged it sufficiently to receive the tap, at the same time forcing in the metal



Mending a Boiler.

and increasing the surface which would bear on the tap in cutting the thread. After threading the hole I inserted a plug and stopped the trouble. The sketch I send shows the way it was done. I found two other small rusted spots on the top of the boiler, which I have told the owner will eventually become leaks. This is not my first experience with holes of this character in a galvanized iron boiler. I have put eight plugs in a boiler in the house of one of my customers, and have found that a galvanized iron boiler will frequently show a tendency to rust out in spots in from four to six years. Sometimes they last longer—to 12 or 16 years—but in my experience I would consider a galvanized boiler that had been in use 20 or 25 years without developing any of these rust spots, which eventually become holes, as one of extraordinary durability. I thought that this experience and method of mending a boiler might be of interest to some of your readers and have sent it in.

CHAPTER III.

CIRCULATING PIPES.

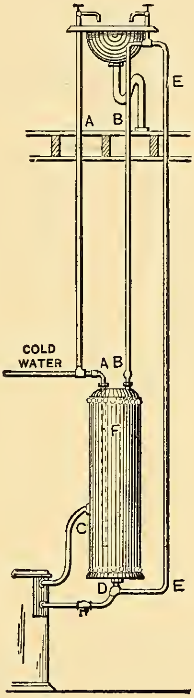
In order to get hot water promptly at faucets some distance from a boiler, and to avoid waiting and the waste of all the cold water in the pipe by running it off before the hot water comes, a pipe is returned from the furthest faucet to the boiler, so that the water will be kept in circulation and hot water always be ready to flow the moment the faucet is opened. Sometimes the return end of this circulating pipe is connected with a special opening at the top of the boiler, which has a tube connected with it running down into the boiler as far as the supply pipe tube. At other times the return end is connected with the pipe at the bottom of the boiler that runs to supply the water back. This pipe should be smaller in size than the regular service pipe, as it is only intended to bring back the water that has cooled and make room for the hotter water. Naturally, this pipe wastes some heat, and if of full size would make unnecessary loss.

CIRCULATING PIPE ON A RANGE BOILER.

From Young Mechanic.—Please inform me where to put a circulating pipe on a range boiler and how high to carry it up.

Note.—In order to cover all points of this inquiry a drawing is given of an ordinary circulating boiler, and its connections lettered so that the explanation may be made clear. A is the supply pipe, and connects with either of the openings in the top of the boiler, providing the tube shown by the dotted line connected with it extends down below the point C and within one foot of the bottom of the boiler. There should be a ⅛-inch hole in the tube at F near the top to prevent syphonage. B is generally called the distributing pipe, though sometimes the circulating pipe. If the query refers to this pipe with the intention of avoiding the usual wait for hot water at a washstand in a third story or distant room until all the cold water in the pipe has run off, it should, after connecting with the faucet,

instead of stopping there, be reduced in size and run back to the boiler, as shown by E, and connect with the pipe D, which takes the cold water from the boiler to the water back. Then, as the water cools at the distant stand, it will drop down the pipe E and permit hot water to come up B and always be ready immediately when the faucet is opened. When a pipe like E is used it is called a



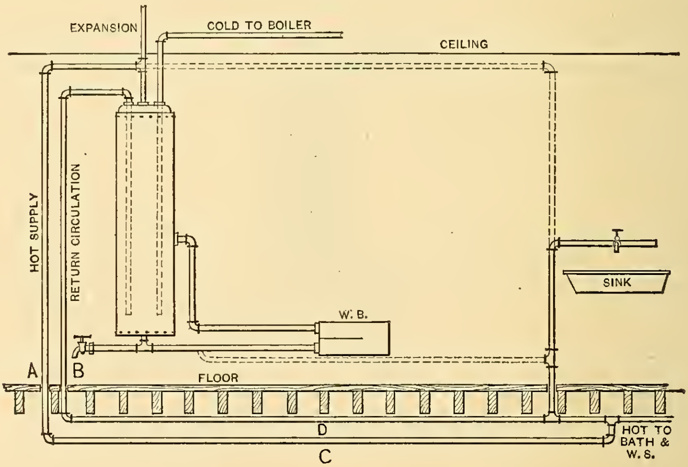
Circulating Pipe on a Range Boiler.

circulating pipe, and must necessarily go to the highest point to which the hot water is carried, and this point is determined by the pressure or force on the supply pipe. The pipe C is far more generally known as the circulating pipe, and connects with the top opening in the water back and the opening in the side of the boiler. There is an advantage of some importance to be gained by having the pipe C one size larger than the pipe D, for when the water is expanded by the heat in the water back it finds

its way to the boiler in a larger pipe much more readily. The bottom of the boiler should preferably be enough above the water back level to permit an easy turn and a slight decline in the pipe D. Circulation will go on if both of the water back pipes are of the same size and the boiler is so set that the pipe C enters only a few inches above the water back level, but that practice should be avoided. There should never be even a slight drop in the pipe C from the time it leaves the water back till it enters the boiler. The hight of the point at which C enters the boiler is fixed by the boiler makers, and is usually about one-third of the hight of the boiler from the bottom.

ARRANGEMENT OF CIRCULATING PIPE.

From J. B., *Hudson, Mass.*—I inclose a rough sketch of a system of plumbing work. What I wish to know in regard to it is this : When the water is hot



Arrangement of Circulating Pipe.

in the boiler, will it circulate through the circulation pipe B D when the faucets are closed? You will see by the sketch that the hot water pipe on leaving the boiler goes to the ceiling, then down 10 feet into the room below, thence 12 feet on a level, and returns to the boiler by the same route, the sink being as per sketch. I claim it will not circulate. Am I right?

Answer.—Our correspondent is correct in his views. Circulation will not take place with such an arrangement—that is, as far as ac-

complishing the desired end is concerned. It is doubtful whether the slightest movement would take place without inducement by drawing at the faucets. We suggest the changes indicated by the dotted lines in the sketch. Pipes A, B, C and D would then be unnecessary.

VALVE IN CIRCULATING PIPE.

From G. B. S., *Buffalo, N. Y.*—In discussing the question of circulating pipes I would state that in using a circulating pipe to insure a constant flow of hot water, there are two ways of looking at the matter. It is undoubtedly a convenience if hot water can be had at any time without waiting, but if it costs anything to heat the water, a supply cannot be had without increasing the expense. Keeping the pipe warm will entail a cost just in proportion to the area exposed to radiation and to cooling influences ; and it will cost less to heat the pipe after it has cooled than to keep it hot. This fact is too obvious to need more than the bare statement. The prevention of a mixture of cold and hot water being drawn from a circulating pipe may be partly accomplished by putting a cock in the circulating pipe, nearly throttling it, so that it will pass barely sufficient water to maintain the desired heat in the service pipe. It may be wholly accomplished by using a check valve instead of the throttle ; the valve being reversed so that it will fall open at ordinary times, and close by the current of water set in motion when any is drawn. The valve must be light, so as to be readily seated by the current. This plan is in use and operates well. To prevent "water hammer," which may prove to be an annoyance, air vessels should be attached to the pipe on either side of and as close to the check valve as they can well be put.

TROUBLE WITH A CIRCULATING PIPE.

From J. M., *Odebolt, Iowa.*—I have a problem in some boiler and range connections, and would be thankful for any information that would lead to a solution of the problem. I inclose drawings of the work as it now is, Fig. 1, and as I think of rearranging it, Fig. 2 being the proposed alteration. I do not wish to change the work unless it will give better results than it does at present. My desire is to be able to draw hot water instantly when the hot faucet at the washstand is opened, instead of having to draw the dead water between the stand and the boiler first. It is to avoid this waste of water that I wish to em-

body the feature of return circulation in this job, and I trust that you or some of the readers of *The Metal Worker* will show me the proper way to do it.

Answer.—The proposed plan shown in Fig. 2 can only be con-

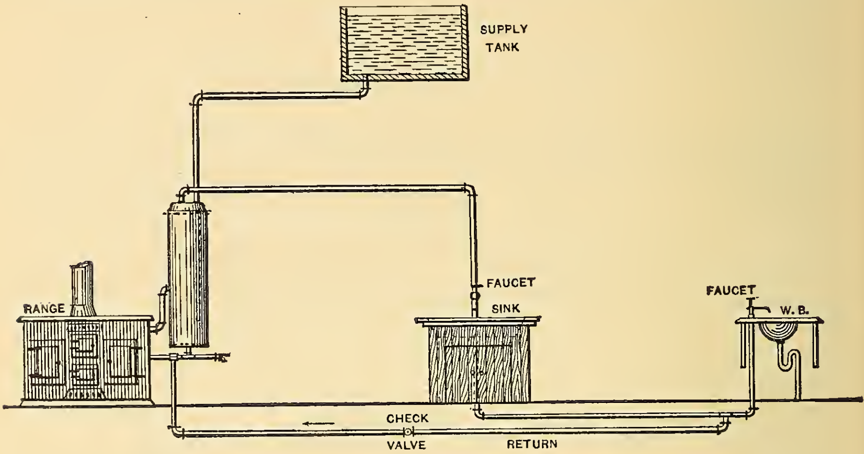


Fig. 1—The Original Arrangement of Pipes.

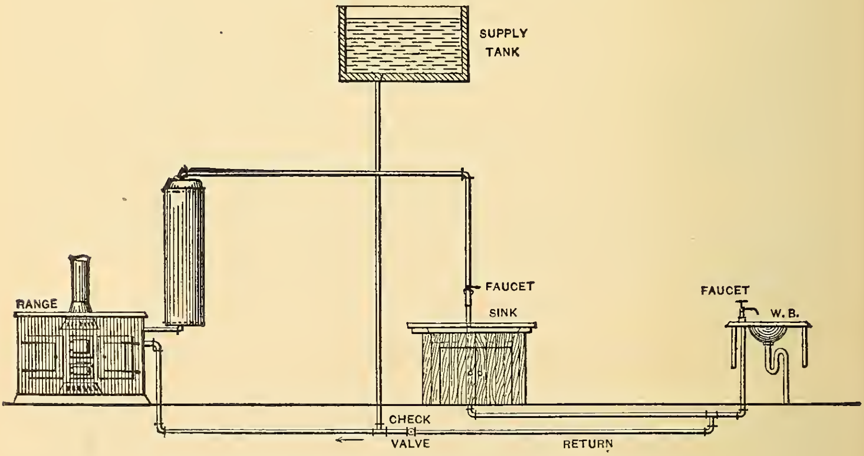


Fig. 2.—Arrangement Proposed by "J. M."

sidered for its novelty and should not be put in practice, as it is open to many objections and would be a very slow heating arrangement. In Fig. 1 it would be quite possible to draw cold water at the wash-

stand if the check valve was not used. Check valves should not be needed in well arranged work, but the end they accomplish should be secured in some other way. Fig. 3 shows a method that will be satisfactory, as it carries the hot water direct to the washstand

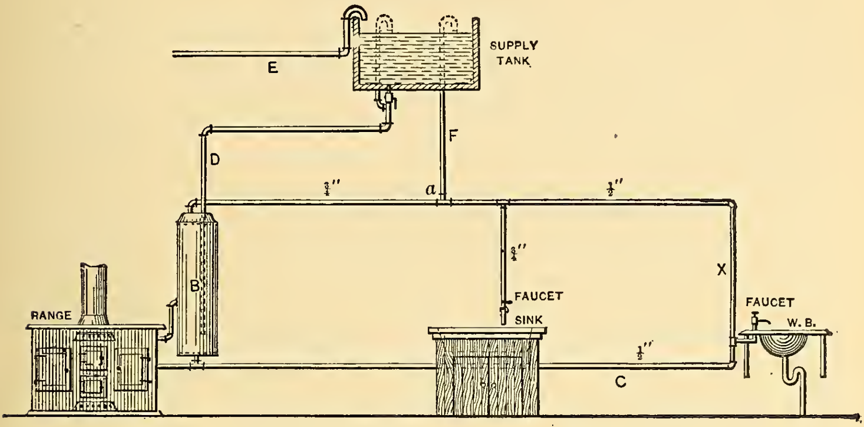


Fig. 3.—Showing Proper Arrangement of Pipes.

before it starts to return and the effect of a check valve is secured by making the return pipe of a smaller size than the main flow. A ⅜-inch pipe would be used on a job where the tank was higher above the fixtures.

CHAPTER IV.

MULTIPLE CONNECTIONS.

Where a large supply of hot water is required and a large boiler is used, it is not uncommon practice to couple several water backs to the bo ler. In some cases where the heating capacity of the water back has been sufficient more than one boiler has been coupled with a water back, but this is unusual Sometimes a boiler is connected with two water backs, one of which is in the stove that is used during the winter season and the other in the stove that is used in the summer, and so arranged that the circulation through either water back can be cut off by stop cocks, or the heating capacity of both used when a large quantity of hot water is desired. In running the pipes for such connections everything should be done to favor circulation and provision made for a drain cock to empty the pipes when not in use, to prevent them freezing.

ONE WATER BACK AND TWO BOILERS.

From W. C. S., *Alexandria, Va.*—I inclose sketch showing boiler connections, and wish to know why the water does not circulate properly. Boiler No. 1, holding 20 gallons, did not give a sufficient supply of hot water, and I therefore connected with it boiler No. 2, holding 35 gallons. After emptying No. 1, No. 2 refuses to act, although filled with water, the cock at sink drawing cold water. When drawing hot water at the sink the side connection becomes cold when boiler No. 1 is exhausted. Please let me know what the trouble is.

Answer.—Fig. 1 is a reproduction of the sketch furnished by our correspondent with the reference letters added. Fig. 2 illustrates an arrangement of pipes which will tend to produce circulation in the two boilers. To facilitate the explanation, reference letters are used in Figs. 1 and 2. F denotes the flow pipe from back to boilers, R the return pipe from boilers to back, C the cold water supply pipes, H the hot water supply pipes from boilers to faucets and fixtures, and H^1 vertical hot water pipe on No. 1 boiler. In Fig. 1 R^1 indicates "trap" in return pipe between No. 1 and No. 2 boilers. It is

apparent from the arrangement of pipes shown in Fig. 1 that the two boilers are not connected to the water back, cold water supply, or to the distributing hot water pipes in the same manner, the piping of boiler No. 1 being more favorably arranged at three points: 1. The return pipe R, Fig. 1, is not "trapped" between the water back and boiler No. 1, whereas the return pipe R¹ is considerably "trapped" between water back and boiler No. 2. The effect is that when cold water enters through pipe C it passes to water back through pipe R, retarding, and it may be said stopping, circulation

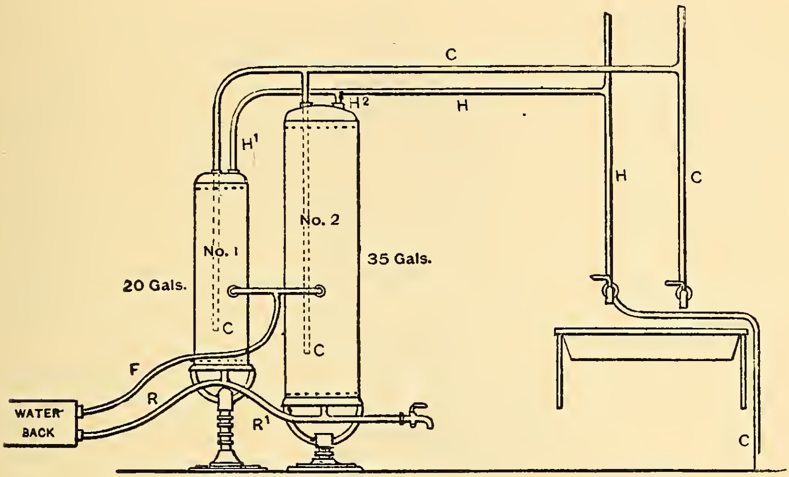


Fig. 1.—Faulty Way of Connecting.

in pipe R¹ of boiler No. 2. 2. The cold water supply through pipe C (Fig. 1), boiler No. 1, is more favorably arranged than through the pipe C, boiler No. 2. 3. The hot water supply pipe H¹ (Fig. 1), from boiler No. 1, offers less resistance to the flow than the hot water pipe from No. 2 boiler, because the cold and hot water pipes of No. 1 boiler offer less resistance in changing the directions of the flow than is presented in the same pipes from boiler No. 2. It is quite possible that the water in these two boilers becomes heated with the pipes connected and arranged as shown in Fig. 1, on account of the circulation between the water back and boiler No. 1 and the circulation between No. 1 boiler and No. 2 boiler. When the hot water faucet is opened hot water flows from the smaller boiler,

No. 1, because the cold and hot water pipes connected to this boiler No. 1 are more favorably arranged, as already described. The water thus drawn off is replaced by cold water through pipe C in boiler No. 1, which passes to water back through pipe R, and from water back through pipe F into boiler No. 1, cooling side connection, because the back will not heat the water as quickly as it can be drawn off from boiler No. 1 through pipe H^1 to faucet. The passage of this cold water through pipes R, F and H retards, and it might be said cuts off and nearly stops, all circulation between the boilers Nos.

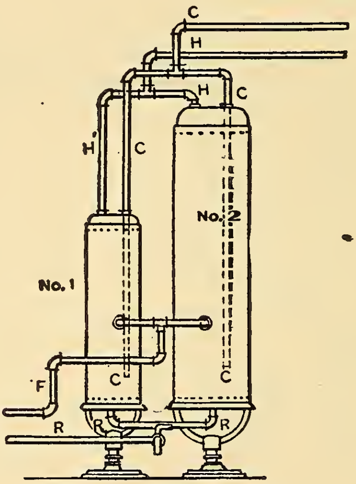


Fig. 2.—Correct Way of Connecting.

1 and No. 2 and between the water back and boiler No. 2. Thus the heated water remains in No. 2 boiler, as would also cold water, because the easiest and most favorable circulation offering the least resistance between the cold water supply and the open faucet is through the pipe connections of No. 1 boiler.

To overcome this difficulty of unequal circulation it will be necessary to place each boiler under equally favorable conditions as to the pipe connections as far as practicable. Such an arrangement is shown in Fig. 2. The connections of flow pipe F on sides of boilers and the openings of cold water pipes C within the boilers should be level, as well as the connecting pipes R and H between the boilers.

When the pipes are thus arranged any displacement that takes place in the water back promotes a nearly equal delivery into each boiler, with at the same time an equal discharge from each boiler through return pipes R R into water back. When water is drawn off at the hot water faucet an almost equal discharge will take place from each boiler, the difference being due to the slight excess of friction in pipe H, Fig. 2, which practically will be imperceptible, while the water withdrawn at the faucet will be replaced in each boiler at about the same rapidity.

BOILER CONNECTED WITH IRON PIPE.

Range connections, except in the very best jobs of plumbing, have received less attention from the generality of plumbers than any other branch of the trade. To meet the great and increasing demand for such goods, innumerable designs of range boilers have been put upon the market. Some styles of range boilers cannot be used except under certain conditions, and the plumber who works a boiler into a place not suitable for it, just because he has it in stock, does himself an injustice as well as his customer. The plumber should not expect his customer to direct the work. Notwithstanding that the range connection is one of the most important features of modern plumbing work, the plumber will often, when the customer says "Do it as cheap as you can," do what he knows is going to be a failure, and then console himself with the delusive thought, "I was ordered to do so," instead of explaining that the really cheap way to do work is to it properly.

A range connection, if improperly made, is a perpetual expense and annoyance Therefore, let the plumber display the best of his ability in making it properly. Also let him put in the best of and all new pipe and fittings. When a range connection shows signs of being "rusted out" and it has been long in use, the plumber may very conscientiously put in an entire new connection, as it is no economy to the customer, and surely no credit to the plumber, to be repairing first one end and then the other of a connection, thereby straining and injuring the joints that are sound. A great deal of trouble may be traced to the disproportion of water backs and range boilers, especially in rented houses. One class of tenement houses have boilers ample enough for any service that can possibly be needed from them, while another class have boilers that

will only furnish hot water for a small family when connected to the proper size of water back or front. Consequently some persons' boilers "steam" and others do not get hot at all, because they cannot afford to adapt the stove to the boiler and the landlord will not adapt the boiler to the stove. Another cause of trouble s that one tenant moving into a place finds that the party who preceded him did not use the range boiler, and for some reason, perhaps to save expense in some former repairs, the sediment pipe has been cut loose from the sink waste and not connected again. Instead of connecting it, the plumber takes it out to stop cock near boiler and tells the cook to draw the water from the boiler in buckets in order to clean it, &c.; but the cook finds it too much like work and neglects it until a deposit of mud has baked on the inner surface of the water back and connections, thereby lessening their heating and circulating capacity respectively. A rapid circulation is the vital point in water heating, and the fitter should bear in mind that anything which will retard the circulation is equivalent to losing heat and it should be avoided.

No matter where circumstances compel you to place a range or boiler, make the connections as direct as possible. Use as few fittings as will answer the purpose, and never use quarter bends where fittings with less angle will answer, as shown by Figs. 1 and 2.

In Fig. 1 it will be seen that a pipe put in as per dotted line will not only save one fitting and 9 inches of pipe, but will reduce the friction equivalent to the difference between the friction of water flowing through 27 inches of straight pipe and the same flowing through 36 inches of pipe and turning an angle of 90°. Also, the trouble from incrustation in some cases would be a fraction less and worth considering, by taking the shorter route. In Fig. 2 the friction of turning an angle of 90° and flowing through 9 inches more of pipe would be avoided. To be brief, in any place where the hypotenuse of an angle can be followed it is sensible to do so, unless there is some special reason why the angle should be made, as in case of placing a drain or sediment cock. Open pattern or long sweep elbows are good, but pipes properly and accurately bent and furnished with ground joint unions are best. Where common unions are used they should be joined with asbestos or pasteboard washers.

Either plain iron, galvanized iron, copper or brass pipe may be used. Lead, if employed at all, should not be used on the top con-

nection, except temporarily. Notw thstanding that the damage of what might otherwise have been very serious accidents has been limited to wet kitchens, in some cases by the bursting of lead connections near the water back when fires were built in the range

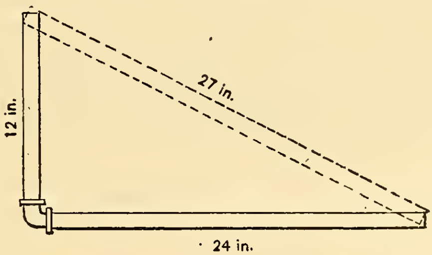


Fig. 1.—Two Ways of Running Pipe.

while pipes were frozen, I believe that the objections to using lead pipe for range connections are greater by far than the points in favor of its use.

Range boilers should be set high enough to allow for draining into kitchen sink when practicable. The sediment pipe should

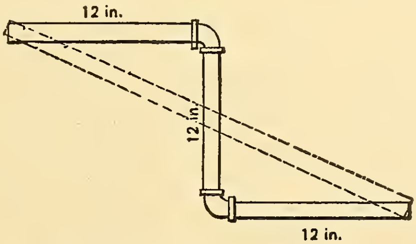


Fig. 2.—Avoiding Quarter Bends.

have a stop cock and be taken from the lowest point in flow from boiler to water back, and when run into the kitchen sink waste it should be above the trap. The sink waste and trap may be cleaned by holding a cloth over the sink strainer and overflow and turning on the sediment cock. This method is more convenient and effective than using a force pump.

Where the water supply contains much sediment, a sediment chamber with bottom trap screw should be screwed into the bottom connection. The sediment pipe may be connected to the chamber.

as shown by Fig. 3. A round way cock should be put in between the sediment branch and the boiler; by shutting this off and opening the sediment cock the full force of supply may be obtained to clean the water back. The boiler may be cleaned by emptying and then turning on the water with sediment cock open, which will allow the delivery pipe in boiler to rinse it clean. The sediment pipe should be as large as the supply to keep it from filling up into the boiler too quickly, which would stop the rinsing. Also the boiler may be emptied quicker when the sediment pipe is large.

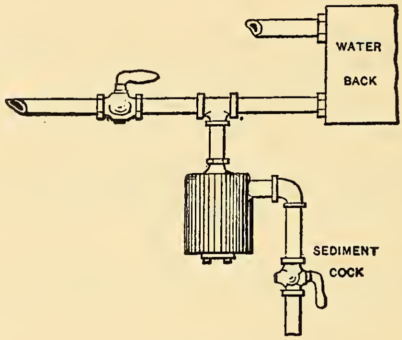


Fig. 3.—Sediment Chamber.

I will now mention a few questionable points concerning the present general manner of connecting range boilers.

1. The supply is introduced through the top of the boiler and carried down nearly to the bottom, where it discharges from the open end. The delivery pipe has a hole in it near the top end to prevent syphoning, and this hole is often filed instead of drilled, which reduces the metal on each side of the hole. After being used a while the hole becomes much larger from corrosion. Now, this "syphon hole," as it is called, delivers a jet of cold water into the hot water in the top of the boiler while hot water is being drawn, and in some cases, unless the boiler is large or very hot, it cools the water to a noticeable degree in a short time of drawing.

Assuming that A is the heating capacity per minute, that B is the water issuing from syphon hole while water is being drawn from hot faucets at the rate of $A \times 2$, and that the absorbent power of $B = 15$ per cent. of A, it will be seen that the water drawn has been appreciably cooled by warming B. Why not put in an automatic

air valve or pet cock on the cold water pipe on top of boiler, instead of the syphon hole?

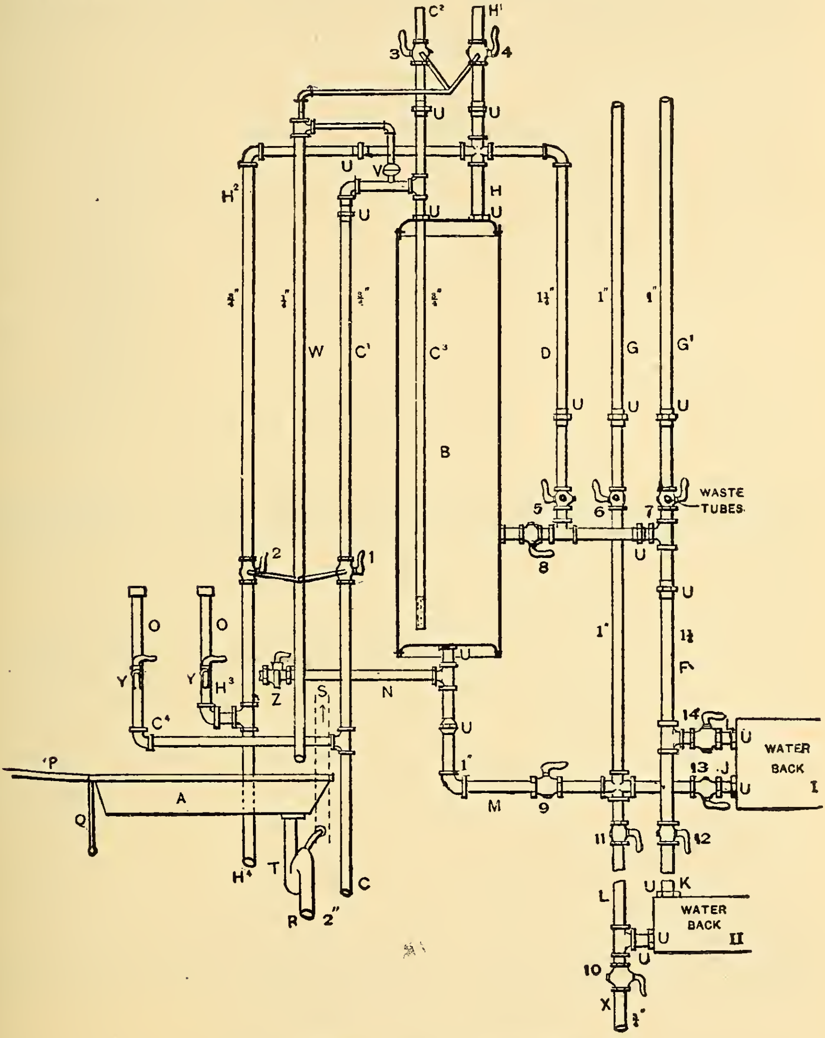


Fig. 4.—Range Boiler and Connections.

2. It is rarely that any provision is made for drawing hot water immediately after the fire is started.

3. There is no arrangement made for cleaning the water back.

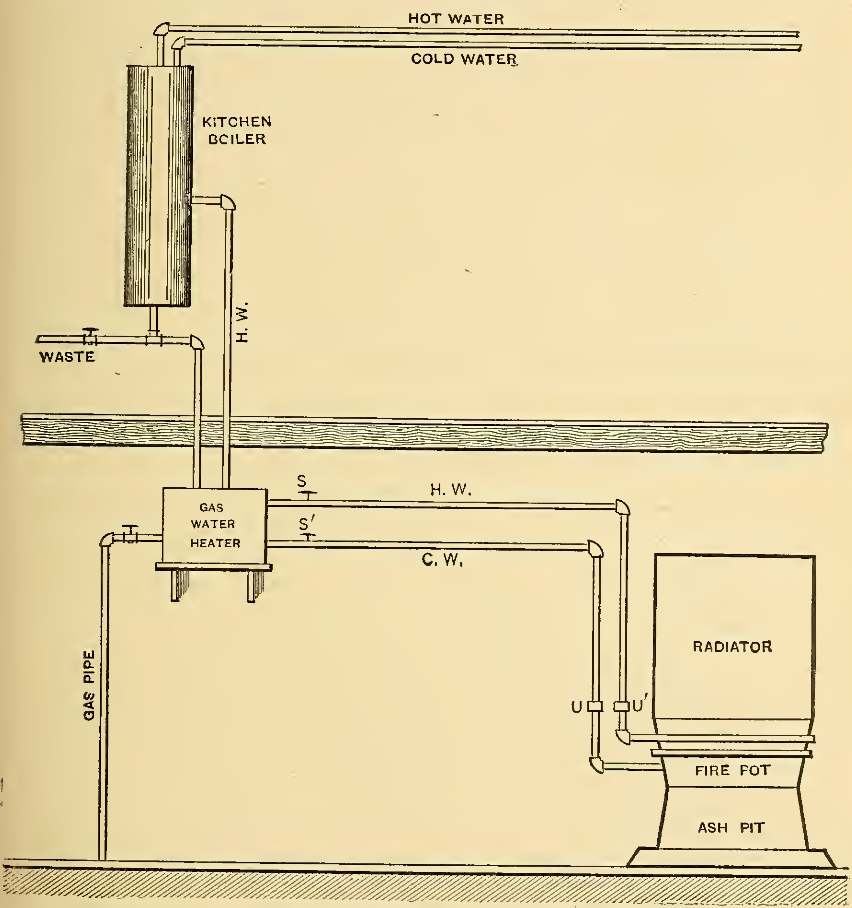
Fig. 4 shows the arrangement of a range boiler and connections

which has given satisfaction. Any special feature of it may be omitted without interfering with the balance, or any part of it may be used independent of the other. The boiler is connected to two ranges, one on the first floor and the other in the basement. There is also a radiator in the bathroom that may be heated by either range. Reference letters in Fig. 4 are as follows: A is the kitchen sink; B, a 60-gallon galvanized boiler; C is the cold main; C^1, cold to boiler; C^2, cold to bathroom; C^3, cold delivery in boiler; C^4, cold branch to sink; D, special for immediate hot water; F, 1¼-inch circulating pipe from water backs to boiler; G, 1-inch return from bathroom radiator; G^1, 1-inch flow to radiator; H is the main hot supply; H^1, hot to bathroom; H^2 and H^3, hot to kitchen sink; H^4, hot to laundry; I and J are circulating pipes to water back No. 1; K and L are the same to water back No. 2; M, 1-inch circulating from boiler to water backs; O, O are air chambers over sink faucets; N is a pipe supplying faucet Z from the bottom of boiler; P, sink drainer; Q, bracket supporting sink; R, sink waste; S, air pipe to roof from crown of sink trap; U, U, U, unions; T, sink trap; V is an automatic cock on cold water, which opens when the water is shut off to admit air; W is a ½-inch waste leader from cocks 1, 2, 3 and 4; it also furnishes air to V; X is the sediment pipe; Y, Y are the sink faucets.

The waste of cock No. 2 is turned down to prevent it from wasting when shut off. To use water back No. 1, turn on cocks Nos. 9, 13 and 14 and shut off Nos. 11 and 12. To clean water back No. 1, shut off cocks Nos. 9 and 12 and turn on Nos. 10, 11, 13 and 14. To use water back No. 2, shut off cocks Nos. 10, 13 and 14 and turn on Nos. 9, 11 and 12. To clean water back No. 2, shut off cocks Nos. 11, 13 and 14 and turn on Nos. 10 and 12. The boiler may be emptied through faucet Z or cock 10. For general use, cock No. 5 is kept shut off. Hot water may be obtained in five minutes after the fire is started by turning on cock No. 5 and shutting off No. 8. Cock No. 8 is left open while cleaning water backs to furnish pressure, while No. 9 is shut off. Side connection to boiler and cock No. 8 might be omitted if the water supply never fails. Without the side connection, if the supply should fail for an hour and a single bucket of water should be drawn from Z the water in the boiler would be too low to circulate, whereas with it the circulation will continue for days, and some may be drawn from Z when the supply is shut off for repairs, &c. Delivery pipe in boiler is plugged and perforated to rinse the boiler when cleaning.

WATER HEATING BY GAS OR FURNACE.

From E. B., *Chicago*.—The residence of a customer is heated by means of a warm air furnace, and as a gas range is used in the kitchen for cooking purposes the kitchen is also heated by the furnace. A gas water heater is placed on a



Water Heating by Gas or Furnace.

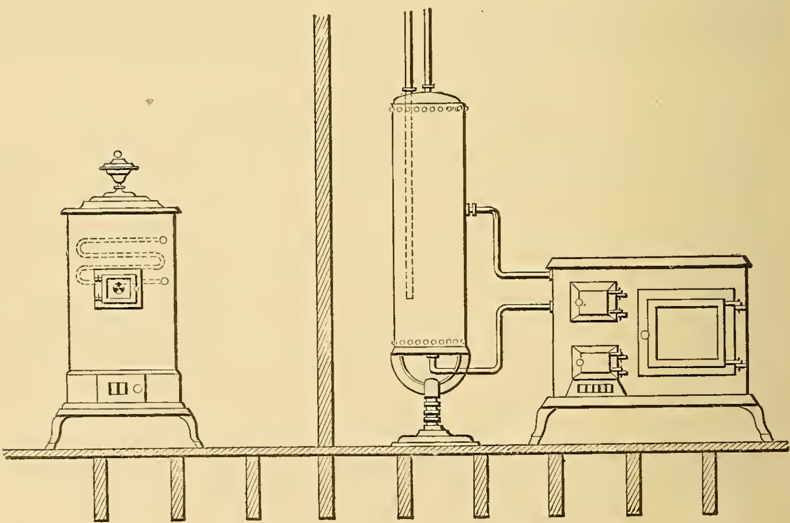
shelf in the laundry and can be used as required. The object of the arrangement shown in the accompanying engraving is to utilize the furnace heat for warming the water during such time as the furnace is in operation ; or should the furnace heat at any time be found insufficient the gas water heater in the laundry can be used in connection with the furnace. During warm weather, or when the furnace is not in use, the gas water heater is to be used for water heating.

Stop cocks are placed between the gas water heater and furnace, as indicated at S S′, and unions are provided near the furnace at U U′. Should repairs be required about the furnace at any time the stop cocks S S′ can be closed and the coil disconnected at U U′. The furnace fire pot is of cast iron, and the iron water pipe being formed about it in two coils the water is rapidly heated.

Note.—Some provision should be made against the possibilities that would arise in case of a fire being started in the furnace when there was water in the coil and the stop cocks S S′ were closed. If another cock was used of the stop and waste style and placed between the furnace and the ell just below the unions U, all of the water would run out of the coil.

BOILER CONNECTED WITH TWO STOVES.

From B. & S., *Franklin, N. Y.*—Will *The Metal Worker* give the best method of doing the work suggested by the accompanying sketch? It represents a 40-gallon boiler connected with a range in a farm house kitchen, which has been in satisfactory operation one year. In an adjoining room, separated by a partition, is a heating stove in which a coil is to be placed and properly



Boiler Connected with Two Stoves.

connected with the boiler. The object is to secure a supply of hot water from the heating stove when the range is not in use, There is about 20 pounds pressure and I wish to ask if it would be advisable to run a supply pipe under the floor to a heating coil in the stove? How many elbows or return bends should be used in the coil?

Note.—A branch from the cold water pipe at the bottom of the boiler should be run under the floor to the coil in the stove. A pipe taking the hot water from the coil in the stove should run up to the ceiling and then through the par ition, where an air cock should be placed, and be connected with the hot water service pipe from the top of the boiler. Some may prefer a more direct connection with the boiler, even by running down and connecting with the return from the water back ; but either way will answer. A condition that may be troublesome will arise when there is a good fire in both stoves, which may heat the water more than is desirable. The size of the coil in the stove and the number of elbows or returns to use is difficult to decide without knowing the size of the stove and how much of the time its door is left open to check the draft. However, to give something that our correspondent can use as a basis from which to make a decision according to his own judgment, with all the conditions before him, a coil of 1-inch pipe running once around inside of a 14-inch cylinder stove and located just above the top of the fire would do the work. Such a coil would not interfere with adding fuel, and if the door of the stove was opened the inflow of cold air would not strike directly against it. If a coil is used as shown in the illustration more surface should be exposed in it to do the work, possibly one-third more.

BAD CIRCULATION WITH TWO WATER BACKS.

From W. C. K., *Oakland, Cal.*—Will you kindly inform me through the columns of *The Metal Worker* how to prevent the hammering and thumping of the pipes and boiler whenever the fire is started in either range illustrated in the accompanying sketch, Fig. 1 ? The hot water or upper pipes are marked A from the water back and run horizontally. I was thinking of putting a stop cock in the hot water pipes at the points marked B, to be stopped from the range which is not used while the other is used, but decided not to do so, thinking it might be forgotten when used, which would be worse than a hammering noise. The water backs are not choked up or filled, but have worked so from the beginning. The water backs and pipes leading to the boiler are ¾ inch. The pipes marked C are cold water and D and D are sediment cocks.

Answer.—To simplify our answer to our correspondent's query we have reproduced his sketch, Fig. 1, and added another sketch, Fig. 2, with letters for reference, and in which the heavy black lines indicate the changes required and the dotted lines the existing arrangements. The arrows we have also introduced. To account for

the noises it is necessary to consider the arrangement of the pipes and the course provided for circulation when the fires are lighted

First we will take the rarge in kitchen. When the fire in it only is started the heated water or water of less density or weight is forced up by gravity in the direction of the arrows along pipe A2, B1, Fig. 2, and up to A1, partially heating the water between A1 and A3.

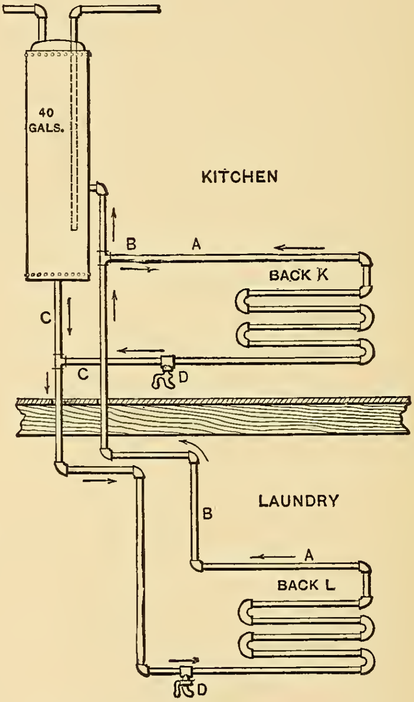


Fig. 1.—Sketch Submitted by "W. C. K."

This operation reduces r latively the density or weight of the water in the column A1 A3 A4 A5 A6 C4, and the column of water F C1 C3 G, being colder, is more dense or heavier, and raises the column C4 to A1. The cold water at F, by the law of gravity, will descend more rapidly through C1 to G than it will pass at right angles in a horizontal direction to C4. Only a little water through pipe C2 supplies the displacement in back K when the fire is first started, and as the temperature of the fire increases on account of the short or meager

water supply steam is readily produced in back K. The steam from back K heats the water in pipe A3 to A1, and as circulation is produced in the manner already described from F to G and C4 to A1, a continuous supply of cold water is maintained at the opening of the pipe B1 A2, from which the steam passes to A1 A3 pipe and is

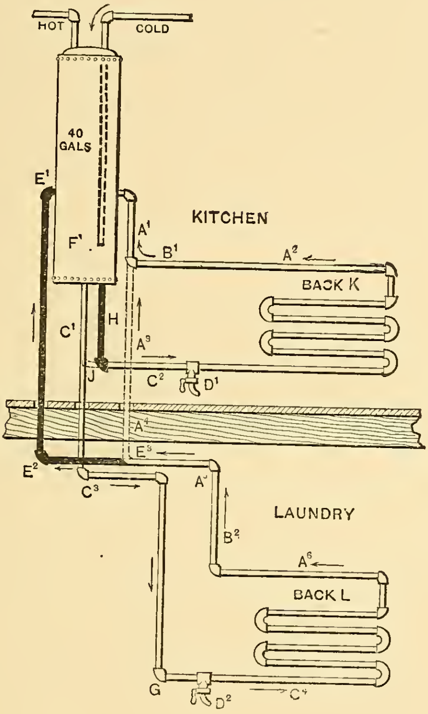


Fig 2.—Proposed Change in Pipe Connections.

condensed. This rapid condensation of the steam produces the noises.

In the second case, where the fire is lighted in back L and not lighted in back K, the heated water is forced upward by gravity in the direction of the arrows along pipe A6 B2 A5 A4 A3. At B1 a part of this heated water is reduced in temperature relatively and passes along B1 A2 ; that portion of it which is of the highest temperature and least density passes to A1. From A2 the circulation passes through the back K through C2 to pipe C1. As the tem-

perature of the fire increases, the relative temperature in pipe C2 (the temperature in C2 being always less than in A2) also increases and heats the descending column in C1 pipe, gradually reducing and impeding the supply of cold water from F to back L through pipe C1 C3 C4, because hot water does not circulate downward. Ultimately the circulation by means of hard firing may be confined to a short circuit in the pipes from back L, Fig. 2, upward through pipes A6, B2, A5, A4, A3 as the flow pipe, and downward through B1, A2, back K, C2, C3, G, C4 as the return pipe. On account of the short or impeded supply of cold water through C1 from F, because hot water will not circulate downward, steam is readily produced in back L, and its condensation as quickly as produced by the column of water which it is not powerful enough to remove produces the noise within the pipes.

The third case is where the fires are started in the two ranges at the same time. We will assume that both fires are of the same temperature at all times when used together. The heated water or the water of least density is forced toward A1 from the two backs K and L. The circulation through back L is more rapid on account of the hight of the column F G. Nearly all the more dense or colder water falls to G and thence into back L through pipe C4. On account of the impeded and meager supply of water through pipe C2 back K soon produces steam, which is possibly forced out of back K through pipe A2 and C2. This steam will be condensed more rapidly at the opening of pipe C2 into pipe C1 than at B1 into A1 pipe, the water in pipe C1 being of a lower temperature than in pipe A1. This condensation of steam in pipe C1 impedes the supply of cold water from F—that is, impedes circulation to back L—which also produces steam, and the condensation of which produces the noises complained of.

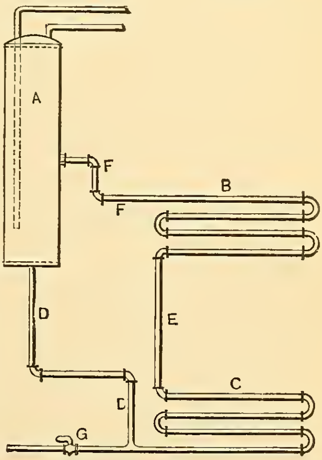
A fourth case may be stated when the fires in the two ranges are assumed to be of unequal temperatures. Under such circumstances impeded circulation, steam and its condensation, with the accompanying noises, will also occur.

It is now apparent that the cause of the noises is due in the first place to the arrangement of the pipes, which do not permit circulation to take place in accordance with the laws of gravity. The result of such an arrangement is the stoppage of circulation by the production of steam, and the condensation of this steam is the cause of the noises.

The remedy, therefore, lies in a rearrangement of the pipes. The changes required are shown by heavy black lines on sketch, Fig. 2. It will be observed that the change in the pipes to back L is in the flow pipe and that to back K in the return pipe. The pipe A3 A4 on the flow pipe of back L is removed, and in its place the pipe E1 E2 E3 is used. The connection E1 need not be placed opposite connection A1, but it will be well to have both connections to hot water reservoir on or near the same level The return pipe C2 to back K will be disconnected from return pipe C1 at J, and the pipe H used so as to connect the back K directly with the reservoir. By this arrangement it will be observed that the circulation between each back and the reservoir is independent, and that whichever back is used there is no circulation possible except through the one heated. Again, there is no circulation possible through the pipes and backs independent of the reservoir. The horizontal pipes will not materially affect circulation, but to insure against any possible dip or trap or improper inclination, it is always well to incline the horizontal pipes in the proper direction. The horizontal flow pipes should therefore incline upward from the backs to the reservoir, and the horizontal return pipes C2 and C4 may incline upward from points J and G to backs K and L respectively, the sediment cocks D1, D2 being placed at the lowest points, J and G.

This is an interesting example of mistakes in the arrangement of pipes, producing defective circulation on account of the pipes being arranged in a manner to interfere with the action of gravity, which is the cause of circulation of water.

From W. H. B., *Scranton, Pa.*—In answer to "W. C. K." you give two cuts of double water back connections. While I think No. 2 would work all right, would there not be danger of the coil in the laundry freezing up? Circulation would cease in this pipe as soon as the fire was drawn. Secondly, would an old boiler stand tapping? I inclose a drawing showing a double water back connection, of which I would like to have your opinion. In the sketch A is the boiler; B, coil in kitchen; C, coil in laundry; D, cold water pipe; E, connecting pipe between coils; F, hot water



Pipe Arrangement Suggested by "W. H. B."

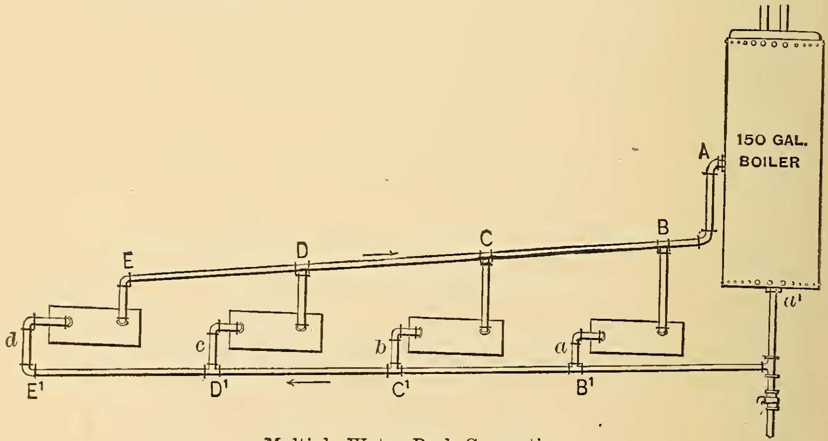
pipe ; G, sediment pipe. This plan will prevent freezing as long as there is fire in one or the other of the stoves.

Answer.—When replying to the queries referred to by our correspondent, the matter of circulation was alone considered. If the laundry is not heated and freezing temperature possible, the water in the laundry coil is liable to freeze when not in use, as there will be no circulation through it. The thickness of the plates in a new or old boiler is not sufficient to receive a thread ; tapped re-enforcing pieces are generally used.

The arrangement suggested in our correspondent's sketch we here reproduce. By it some circulation is secured through the lower coil when fire is applied to the upper one. Circulation is impeded between the boiler A and the upper coil on account of the trap in the return pipe. When the lower coil is used and no heat applied to the upper one, a regular circulation is secured. If a strong fire is applied to both coils at the same time steam may be produced, and impediments to regular and free circulation are liable.

MULTIPLE WATER BACK CONNECTION.

From F. L. R., *Castleton, Vt.*—I am about to set a boiler and connect it with a four-fire, 16-foot hotel range having four water backs, one in each fire



Multiple Water Back Connection.

pot. I send you a sketch of my plan of connecting the boiler with the water backs. Kindly advise me, through the columns of *The Metal Worker,* if you think my plans are correct, and if they are not, state the proper way of connecting the same.

Answer.—It would be all but impossible to connect four water backs with one range boiler in such a manner as to give entire satisfaction, and it would be still more difficult to obtain good results when an ordinary type of boiler is employed, from the fact that the connections would not be suitable. Such a connection as our correspondent describes is very unusual, the rarity of such and similar work being due to the ever-succeeding trouble from steam, &c. If, for any special reason, however, the method in question is employed, we recommend the following :

1. Let the demand for hot water equal the aggregate heating capacity of the water backs ; also the supply to boiler and the hot water outlet from same be equal to requirements under such conditions

2. That the circulating pipes, as shown in the accompanying engraving, be as follows : The portion between A and B and a^1 and B^1 have capacity equal to the combined capacities of all the branch pipes to water backs from each line respectively, with no contractions at the boiler openings. In this way those sections referred to will carry a surplus equivalent to the capacity of the three backs most remote from the boiler. Likewise, in the manner above described, the sections of pipe between B and C and B^1 and C^1 should have an area equal to *b*, *c* and *d*, thereby insuring a surplus to *c* and *d*, &c., throughout the run.

3. That all general and minor requirements be strictly adhered to—that is, avoid traps, use the minimum number of bends, direct the water from the boiler into the water backs with Y fittings, and from the backs to the boiler in the same manner ; see that the upper holes in the backs are in the highest part of the cavities ; let the lower pipe "fall to" the upright under the boiler, and the return "rise to" the boiler opening A, &c. We are well aware that range boilers do not ordinarily have the openings as large as would be needed in this case, but nevertheless a multiple connection of the kind will require them. If at all practical, it would be far better to use two smaller boilers, one at each side of the range, and connect them in multiples—two to each boiler and each set of connections, independent of the other two ; or have two backs to each boiler and independent connections from each back, entering at opposite sides of the boiler. The hot water outlets of the boilers may then be joined in such a manner as to admit of using their delivery jointly or independently. If there is more heating surface than is

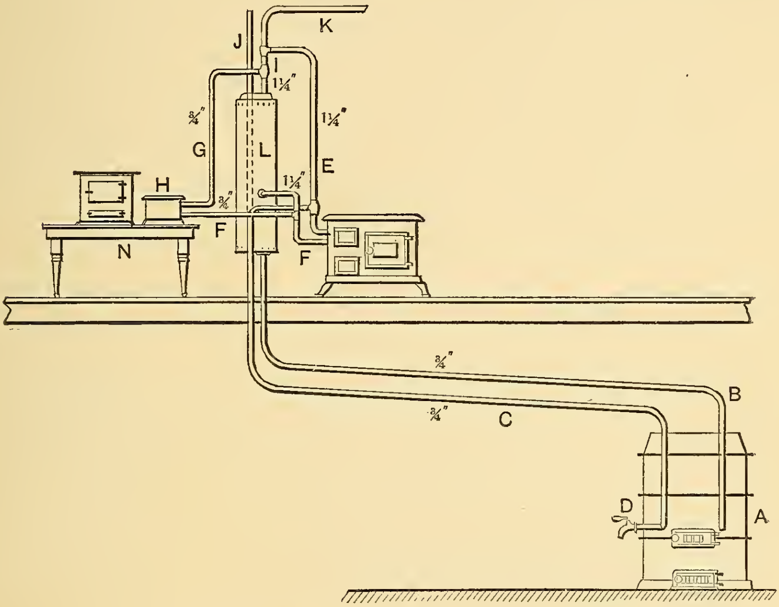
actually needed, some of the backs may be omitted and the fire pot lined with tile instead.

From E. W. C., *Harrisburg, Pa.*—I notice an illustration of a multiple water back connection. I would state that I have a number of ranges in many of our principal hotels connected with a water pot to each fire, giving very satisfactory results, and if your instructions are carried out there will be no failures. The only fault I find is the capacity of the circulating boilers. They should not be less than 300 or 500 gallons, and made with openings in proportion. I have in one hotel a five-section range with five water pots and one 500-gallon boiler, which furnishes hot water for 350 people every day and a public bath in a barber shop, as well as for culinary purposes and washing in laundry, and there is never a lack of supply of hot water. As you state, the ordinary range boilers are not made in the above sizes and they seldom have the openings made for this purpose. I have my boilers built of ¼-inch steel with ⅜-inch heads, all the holes punched and tapped of the proper size. I use brass pipe for making my connections, and all the pipes are outside of range, giving a very neat looking job. I may state here that I have met considerable opposition to the use of the range in hotels as a medium for heating the water to any large extent, but my success has brought all the hotels to having their ranges put to this use instead of having a separate and independent hot water heater. My experience has been that the fault in heating water by these ranges is in almost every case that they have been fitted with insufficient heating surfaces, and the boiler has been too small, the result being that they would draw the water faster than the range would heat it and very naturally give a cold water back, which would add to the cooling of the range oven. There can be no mistake in the multiple system properly applied—that is, provide large heating surface and large boiler capacity.

TRIPLE CONNECTIONS TO BATH BOILER.

From J. W. H., *Montreal.*—Judging from the number of inquiries as to the ways and means of connecting two or more water backs so as to supply hot water from different sources of heat and at the same time have all work well and smoothly into the bath boiler, some information on this point will be of interest. Double and

triple connections are quite common in this town (Montreal), arising from the fact that many of the modern dwellings have their kitchens fitted with gas ranges as well as coal burning ranges, calling for a double connection, and in addition it is the common practice to have a heater fitted into the fire pot of the hot water furnace, thus making three sets of connections into one bath boiler. The secret of success is to give each set of connections its own right of way—in other words, that there be no interference, or, to use an electrical expres-



Triple Connections to Bath Boiler.

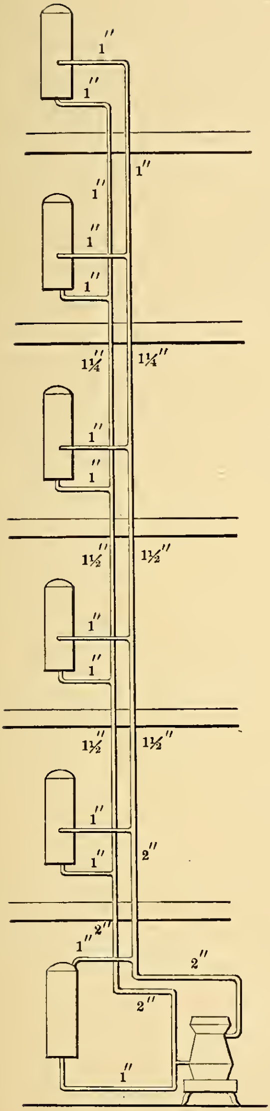
sion, that there be no short circuiting. The accompanying sketch shows a triple connection in use in the writer's house, working well either as single, double or triple connection. The boiler is a 40-gallon galvanized boiler set on a stand in the usual way. To its right front is the coal range used in winter for cooking, to its immediate left is the gas stove with its special gas heater for warming water, while in the basement, some 30 feet away, is the hot water furnace. The connecting pipes are all iron pipe size copper with screw joints and brass fittings, and instead of the usual cast iron heater in the

furnace a $1\frac{1}{4}$-inch copper coil about 4 feet long was fitted close to but not exactly in the coal, which only touches the coil when a heaped up fire is on. An abundance of hot water is the result, and the only difficulty is that occasionally there is too much, but letting one of the cocks remain open a few minutes soon remedies any trouble from that source. In the sketch A is the hot water heating furnace ; B, $\frac{3}{4}$-inch return pipe from bottom of bath boiler L to the lower side of coil in furnace ; C, $\frac{3}{4}$ inch flow pipe from high side of furnace coil to flow from the coal range ; E, $1\frac{1}{4}$ inches, which enters top of bath boiler L as shown ; F and F, $\frac{3}{4}$ inch returns from side outlet of boiler to lower pipe of coal and gas range heaters ; G, flow from gas water heater entering top of boiler through pipe I, $1\frac{1}{4}$ inches, into which E is also connected ; J, cold water supply from city pressure, dotted lines showing pipe inside the boiler ; L, the bath boiler ; N, gas range ; K, lead pipe conveying hot water to the different fixtures ; D, draw off cock.

HEATING RANGE BOILERS FROM BASEMENT HEATER.

The modern apartment house in New York City in many instances is provided with a gas range for cooking purposes, and a radiator is placed in the kitchen connected with the heating system for warming the kitchen during the winter season. The expense attached to heating water with gas for storing in the ordinary range boiler has made it necessary for hot water to be supplied by the owner of the apartment house by special means, some of which have been previously described in *The Metal Worker*. The result of hot water being furnished to tenants in the newest apartment houses has created a demand from those who occupy apartments in older buildings to have the hot water also supplied for their use, and to have a gas cooking attachment applied to the coal ranges already in the building, and which have been heretofore used for heating the water in the range boiler by means of a water back.

In the accompanying illustration we show a system for utilizing these range boilers designed by W. M. Mackay for a customer. In addition to five floors of the building above ground, the range boiler in the janitor's apartments in the basement, where the heater is located, is also supplied with hot water. A small round boiler having a 15 inch grate, and rated to carry 200 square feet of direct radia-



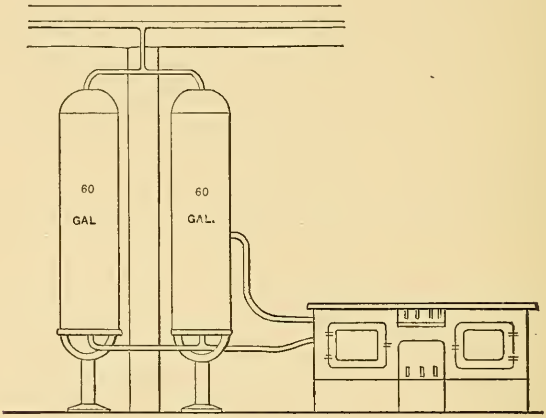
Heating Range Boilers from Basement Heater.

tion and having a capacity for heating 100 gallons of water per hour from 40 to 212 degrees, is connected with the six boilers, as shown, each one of which has a capacity of 30 gallons. A 2-inch flow main is carried up from the little heater and 1-inch branches are taken to the side connections on all the boilers on the upper floors. A tee is used at the side connection to receive the branch from the basement heater and the pipe from the water back in the range. As this main continues upward it is reduced in size so as to insure each of the boilers receiving its necessary supply of water. The return connections from the different boilers run to a return main, which increases in size as it receives the different connections and is carried to the boiler. The boiler in the basement is heated by means of a 1-inch branch, which is connected at the top of the boiler at the hot water service outlet, and the return from this boiler is carried to a separate opening in the base of the water heater.

This method of connecting allows each tenant to use a coal fire when an extra supply of hot water is required for laundry or other purposes. Each boiler is treated as a radiator and piped accordingly. It will be noted that the six boilers have a capacity for holding 180 gallons of hot water, while the heater is only rated to furnish about one-half of this quantity. This seeming lack of power is offset by the storage capacity of the different boilers, and allowance is made for the fact that all of the hot water in a boiler is seldom drawn from it at one time.

TWO BOILERS CONNECTED WITH ONE WATER BACK.

A customer of M. Abbotts' Sons purchased two houses to be used for a large boarding house. They were called upon to equip one of the kitchens with a French range. In the house which had been occupied by the owner there had been complaint that with the range used previous to the alterations it had been impossible to get a sufficient quantity of hot water. In the alterations the range was removed from the kitchen in one of the houses, but the boiler was left, the openings for the water back connections being plugged. In



Two Boilers Connected with One Water Back.

the house where the complaint was made the French range was substituted and connected with the boiler, which was of 60 gallons capacity. After a few days' use the firm were informed that the rang made so much hot water that at times the hot water could be drawn from the cold water pipes in the bathroom, and that there was a continual rumbling and noise in the boiler. This was evidently due to the water back having a greater capacity than was required for a 60 gallon boiler, but not greater than necessary to meet at times the demand for hot water in the kitchen. When called upon to increase the hot water supply, and at the same time to prevent the hot water running from the cold faucets in the bathroom, it was found necessary to separate the hot and cold pipes which ran to the bathroom,

and which had previously run side by side. This overcame the trouble at that point.

They also decided to connect the two boilers so that the water back would have double the quantity of water to work on. The brass connection for the hot water service pipe at the top of each boiler was taken out and the boilers were connected together by means of 1-inch galvanized iron pipe, a **T** being left on this pipe for connecting the main hot water service pipe. The opening in the bottom of the unused 60-gallon boiler was connected into the pipe which carried the cold water from the boiler in use to the water back. This connection has been found very satisfactory, except when the range is fired heavily for special cooking or other work, and there is not a great deal of hot water used. Then heat is sufficient to make the first boiler noisy. The firm are now considering the problem of removing the cause of noise without reducing the capacity to produce hot water when a large quantity of hot water is needed.

CHAPTER V.

DOUBLE BOILERS.

Where the water supply will not rise to fixtures on an upper floor a tank is generally used to supply them, and in order to supply these upper fixtures with hot water a double boiler is used and supplied from the same tank. The double boiler is made in different forms, both vertical and horizontal. Sometimes one boiler inside of another, and again, two short boilers butting together, each connected with a separate water supply and sometimes with a special water heating device or receiver. The one in more general use is a boiler of smaller diameter inside of one of larger diameter. The outer boiler is supplied from the regular water supply and connected direct with the water back. The inner boiler is heated by the hot water in the outer boiler surrounding it and is supplied from the tank above the highest fixtures. The same principles govern the operation and circulation of such boilers as govern in the ordinary single boiler. The receiver mentioned is made with two separate chambers so arranged as to secure an indirect passage of considerable length through which the water flows. One chamber is connected with both the water back and one of the boilers, and the passage of the heated water through it to the boiler heats the water in the other chamber, which is connected with the other boiler only. A more recent practice is to cast the water back with a division, making two separate parts and four openings, connecting a separate boiler supplied from the tank with one part in the usual way and another boiler supplied from the street service with the other part. This avoids cooling the water in the tank boiler when a large quantity of water is drawn from and enters the street boiler, which is experienced with the use of double boilers. The piping between the two boilers is so connected that both are sure to be supplied in case either source of supply fails.

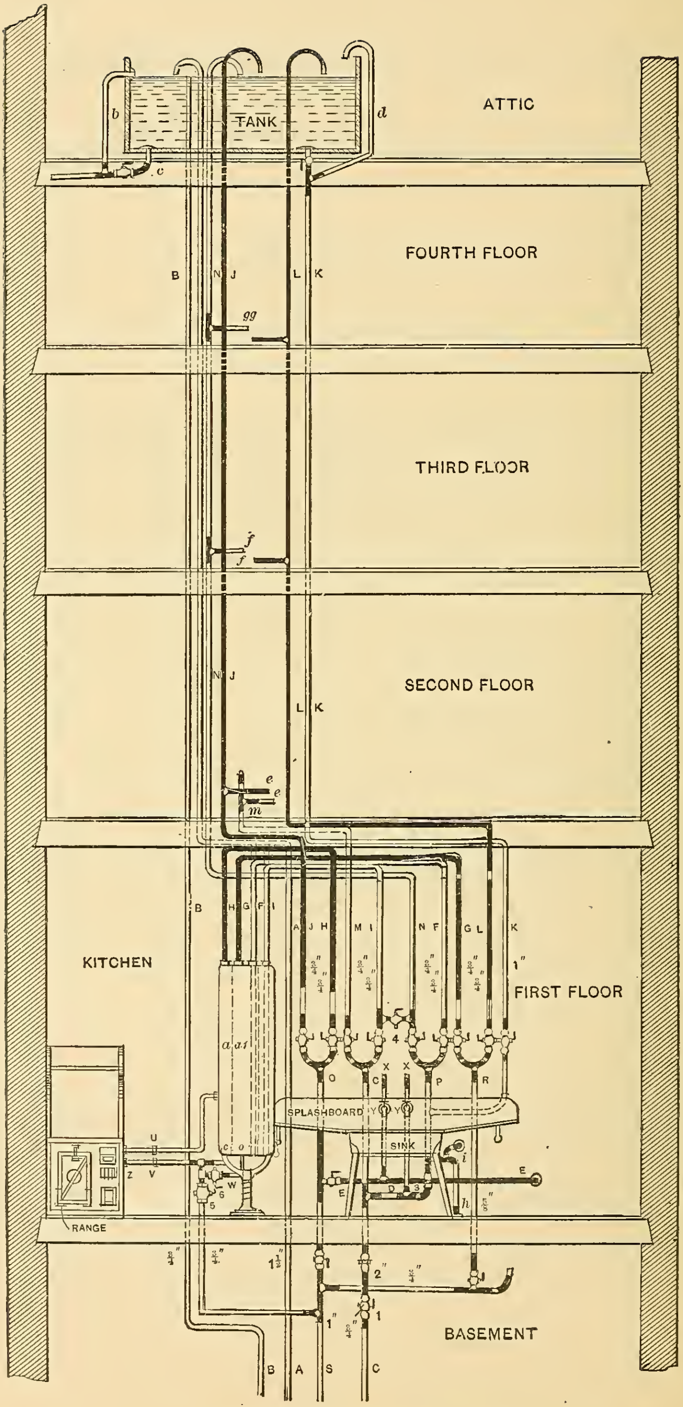
DOUBLE BOILER SYSTEM OF PLUMBING.

The numerous inquiries received for information pertaining to double plumbing is evidence that many plumbers in the country are but slightly acquainted with the system and the conditions which require its adoption.

Although double boiler work is a system of years' standing, the plumbers in general seem not much to blame for their lack of knowledge concerning it, as the conditions favorable to the use of the same can be found in comparatively few places. The plumbers who look no further than their present employment do not care enough to investigate, since they can make no immediate use of the knowledge. However, the truly ambitious plumbers are not satisfied until they are familiar with everything pertaining to their business, because they cannot tell how soon circumstances will place them where they will sadly need the information which at present is not required.

When the plumber is called upon to do a first-class job, it is often optional with him whether he puts in one or another kind of pipe. If, according to his knowledge, he thinks brass pipe will answer best, then brass pipe is used ; but it is quite different in regard to the system to be employed. It is not so much a matter of choice as to whether the single or double system will be used or not. The proper conditions must exist before the double system can sensibly be preferred. A double system could be placed under almost any conditions, but such work in the wrong place would entail more work than would be necessary to place a double system in the right place, in addition to the difference in the original cost of the two systems.

The accompanying illustration shows a double boiler system. Let us suppose that the street pressure will force the water into the tank in attic through A, instead of only to the second floor ceiling, for then the pump in the basement would be unnecessary. The inside boiler A1 and its system of pipe would also be useless. The pipe M could be continued to the fourth floor for cold water and branches made into J for hot water. If the street main furnished regular pressure and clear water, the tank could in some cases be omitted ; but where the tank is omitted the auxiliary to constant pressure is lost—*i.e.*, where tanks are used settled or filtered water and regular pressure are assured, even though the street supply be shut off for repairs for hours, which is not unlikely. Were the pipe A delivering water to the tank from the street pressure, it would have to



Double Boiler System of Plumbing.

be furnished with a ball cock or something equivalent, instead of the bend at the tank, as shown. Any one can see the folly of using such a system as illustrated if the street pressure would reach the attic.

Where the conditions call for double system work, the plumb r is called upon to select and adapt the style most suitable for the place. It will be understood that there are different ways of arranging double boilers and the pipes leading to and from them, and yet give results that are practically the same.

The first method used where there is available space is to place the two boilers independent of each other, either vertical or horizontal, as is most convenient. Having two independent boilers necessitates having two water backs—that is, one fire box with two water backs and connections from each back, making the circulation to each boiler independent of the other.

The circulating pipes must always be from one back to one boiler, unless a range with two fire boxes and two water backs each is used, in which case the tank pressure boiler may be connected with one water back in each fire box and the street pressure boiler connected to the two remaining fire boxes in the same manner. When such a range and connections are used, hot water can be supplied to both systems from either fire box. For some reason the boilers placed independent of each other seem to give the greatest satisfaction.

The second method is the placing of one boiler within the other. The difference between the capacity of the inner and outer boiler should be equal or a little in excess of the capacity of the inner boiler. The strength of the material for both shells can be about the same, and should be sufficient to withstand the effect of a vacuum without injury when formed into a shell the size of the outer cylinder. Should the inner cylinder of such a boiler be emptied or syphoned while the pressure is on the outer shell no damage would be likely to ensue, because the inner shell would only be required to support the weight of the water from the street, increasing in pounds per square inch according to the vertical head of water, in addition to the atmospheric pressure. The inner shell being naturally stronger from its smaller diameter, and having no side couplings to vary the strain or resistance, it would withstand any probable test without injury. It will be understood that the high, or tank, pressure is always connected to the inner boiler. A different result might be expected were the high pressure connected to the outer boiler during

such a test as was mentioned above. In combination boiler work the water back connections are always applied to the outer shell, as one or the other must be heated by conduction.

Although there are few, if any, cases where a combination boiler has been heated by circulation through the inner shell or through both simultaneously from two water backs, there is no reason why the latter could not be done successfully. The inner cylinder should be made of copper, because it absorbs heat quickly. The outer shell, if also made of copper, will secure uniform expansion and make a much more durable job.

One way of arranging the pipes leading to and from a combination boiler is to supply a tank situated in the attic or upper floor from the street pressure by means of a pump upon the first floor or in the basement. The supply to the inner cylinder is taken from the tank, and is also connected to the street pressure, by which, should the tank supply fail, the street supply will fill the inside cylinder through a check valve. The tank and inside cylinder supply hot and cold water to all the floors above those for which the street supply can be relied upon.

Another method is substantially the same as the first, except the additional convenience of being able to send hot or cold water from the tank system to any fixture supplied by the street pressure by means of certain connections and stops properly placed in the kitchen.

A third way of using the double boiler system is as the first, with the addition of what is known as reverse cocks to the branches supplying the fixtures on the lower floors from the street pressure. The reverse attachment referred to has six openings and four stop cocks. They are set as follows: Upon the upper street pressure floor hot and cold branches from both street and tank supplies are brought to some convenient place and carried up through a safe pan, in order that any leakage from the cocks may be taken care of. Both of the hot supplies are connected to one leg of the attachment and cold supplies to the other leg. A lever handle is connected to the attachment cocks in such a manner that it is only necessary to pull up the handle to change from street to tank pressure, or *vice versa.*

A fourth arrangement of the pipes is a combination of the stop cocks in the kitchen, mentioned in the second method, with the reverse attachment, the reverse cock being placed upon the third floor when there is only an intermittent supply from the street to the third

floor. Intermittent supply in some localities is caused by excessive drawing at certain times during the day, which in some cases causes the second floor to be uncertain if the street pressure alone is depended upon. Automatic attachments can be bought from any stock house for uses mentioned above. The object of double plumbing and everything pertaining to it is to avoid the cost of unnecessary pumping, storage capacity, &c., to as great an extent as possible. The true perception of the conditions existing in any case is the greatest aid to rightly determining which of the methods is best for the place, as well as whether combination or independent boilers are most suitable.

Double system plumbing is principally used in three, four-story and attic and five-story buildings, and the neatest examples of it can be found in residences. In high city buildings where high pressure steam is used both for heating and lifting water, other means of abridging the irregular supply difficulty are found. It should be remembered that double boiler work and duplicate plumbing are not the same, the latter being merely a separate supply to each fixture and in some cases both separate and duplicate supplies.

The illustration is an example of double plumbing which differs from the first method described only by having the stop cock No. 4 connecting the cold supply of both boilers above the sink. Should the street supply fail in this case, it is only necessary to turn stop cock No. 4 to supply the hot and cold street pressure system from the tank. A reverse attachment can be placed upon the second floor by simply making connections to N L from *e e* through the reverse cock. The range used in this job is of the ordinary type—*i. e.*, one fire box and one water back. Circulation takes place between the outer boiler *a* and the water back Z through the pipes U V. The emptying pipe shown by W is from the inside boiler A1. Its stop cock No. 6 is connected on the pressure side of cock No. 5, which prevents any possibility of the inner cylinder being emptied while the tank pressure is upon the outer cylinder. T is the sediment pipe through which both boilers must be emptied, and is controlled by stop cock No. 5. S is a general drain, which discharges over the basement sink. To aid the reader in tracing up pipes referred to in the cut, the lines representing hot water proper are made solid black. Cold supplies, C and P, have each a small drain and stop to S from above the check valves, but are not shown in the drawing. Hot supplies are furnished with drains and cocks to S by

continuations of O and R. The sink in this job is of porcelain, supported by legs and furnished with two drainers and marble splash back. The drainers are suppor ed by brackets, and the splash back can be removed by unscrewing the sink faucets Y Y and removing two wood screws at each end. The sink waste is indicated by *h* and the crown vent of its trap by *i*. The telltale pipe B discharges above the basement sink, that the person pumping may know when the tank is full. A is the supply to the tank in the attic, from a hand force pump in the basement. The pump suction pipe is connected to the street supply C. Tank drain *c* is furnished with a cock near the tank. The tank overflow *b* is connected to tank drain *c*. The tank cold main supply is first brought into the kitchen through K, thence through branch N to third and fourth floors, and up over the tank as shown, which insures the main line draining out should the water be shut off. The inner cylinder is supplied with cold water through the branch F from K. Pipe *d* is branched into K below the stop cock as shown, which introduces the atmospheric pressure to the upper end of K, allowing K to be drained without draining the tank, should it be necessary to do so. The street pressure main cold is introduced through C and to the outer cylinder through branch I. Second floor cold is supplied from the street through branch pipe M. The kitchen sink, pantry sink and laundry hot water are supplied through pipes O, E, and their branches. Cold water to kitchen sink, &c., is supplied by branches from street pressure pipe C. Should the tank pressure fail, the street pressure will supply the inner boiler through branch D and check valve 3 ; thence via P and F. Check valve 3 is used to prevent mixing the tank and street water. Were check 3 omitted, high pressure would always be upon the outer boiler and all the water used would have to be pumped, by reason of the excessive pressure holding No. 2 check on pipe C shut. No. 2 check is placed upon street main cold C to prevent wasting the tank water into the street main when both systems are doing duty under high pressure ; that is, when cock No. 4 is turned on. Check No. 2 is also necessary to prevent drawing water from the outer boiler when the pump is in use. H is the main hot supply from the outer boiler, J being the distributing hot to second flo r. G is the main hot from the inner boiler, L being the distributing hot to the third and fourth floors. Both L and J continue up to and bend over the tank in order to relieve any steam, vapor or expansion that may occur. X X indicate the air chambers from the sink

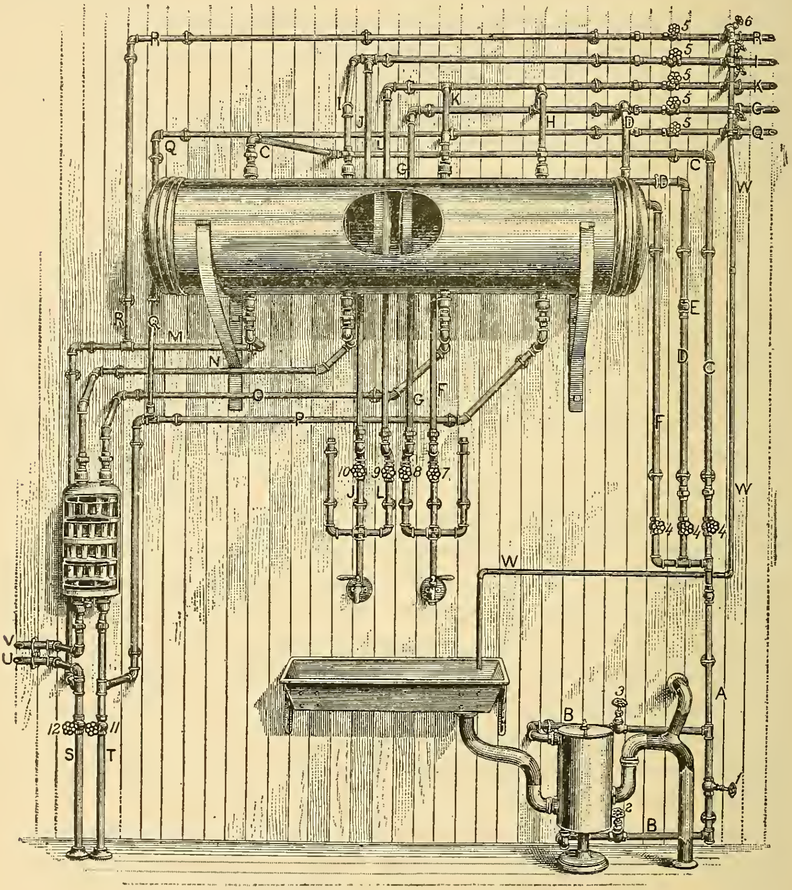
faucets. It will be noticed that all pipes connecting to the top of the boilers are brought down to a convenient point above the sink to avoid using a stepladder when it is necessary to turn the stop cocks. The bends made in the hot pipe for the above reason prevent the successful use of a return circulating pipe. Both inner and outer boilers may have return circulation when the hot mains continue to rise above the boilers. The stops in this job above the sink are all plain stops. All jobs of the order here described should have the stop cocks and valves marked, and a chart giving full information as to the use of each one, both for regular service and in cases of emergency.

HORIZONTAL DOUBLE BOILER.

We use as a sample of horizontal double boiler connections, an illustration of a piece of work erected by E. H. Dow of Sioux Falls, S. D., and W. H. Mattern of Allentown, Pa., of the Plumbing Class of 1891–92 at the New York Trade School. This piece of work was exhibited at the World's Fair at Chicago, and was highly spoken of by visiting plumbers.

The water back is not shown, but the pipes leading from it appear at the left, connecting with the receiver. The boiler is suspended over a kitchen sink that is connected with a grease trap. The apparatus consists of two separate boilers, butting together, one supplied from the street main and the other from a tank. The receiver has two chambers, one heated by being surrounded by the hot water in the other, which connects directly with the water back. AA is the cold water supply from the street main. BB is a by pass running cold water through the outer chamber of a grease trap to cool and harden the grease that collects on top of the water discharged from the sink. C is a branch to supply street boiler. D is a branch connecting tank and street supply to fill either boiler. E is a check valve to prevent tank supply from leaking into street when the latter supply fails. F is street supply to sink. G is tank supply to sink and by branch H to tank boiler and by branch D to street boiler. I is hot service from street boiler. J is branch from I to sink. K is hot service from tank boiler. L is branch from K to sink. M is cold water from street boiler to receiver. N is hot water from receiver to street boiler. O is hot water from receiver to tank boiler. P is cold water from tank boiler to receiver. Q is

return circulating pipe from tank hot service. R is return circulating pipe from street hot service. S, sediment pipe from street boiler. T, sediment pipe from tank boiler. U, cold water from receiver to water back. V, hot water from water back to receiver.



Horizontal Double Boiler.

W, waste pipe to sink from cocks to empty upper pipes and fixtures when supply is shut off. The stop cocks are numbered. 1, stop to street supply; 2 and 3, stops to by-pass and grease trap; 4, 4, 4, stops to sink and street and tank boiler; 5, 5, stops to upper floor fixtures; 6, 6, waste cocks to drain pipes when upper floor fixtures are

shut off ; 7, stop to street supply when tank supply is used ; 8, stop to tank supply when street supply is used ; 9, stop to tank hot service to sink when street hot service is used ; 10, s op to street hot service when tank hot service is used ; 11 and 12, sediment stops to clean boilers and receiver. When tank is empty, tank boiler and kitchen fixtures can be supplied from street by opening stop c cks 4 on pipe D, 7, 8, 9 and 10. When street supply fails, street boiler and kitchen fixtures can be supplied from tank by opening stop cocks 7, 8, 9 and 10 and closing stop cocks 4, 4, 4.

DOUBLE WATER BACK INSTEAD OF DOUBLE BOILER.

From S. P., *New York.*—Will you kindly inform me through *The Metal Worker* if there is any coal burning water heater made with two water backs for supplying hot water in a building where the street pressure is insufficient to reach the fixtures on the upper floors at all times of the day ? The idea is for

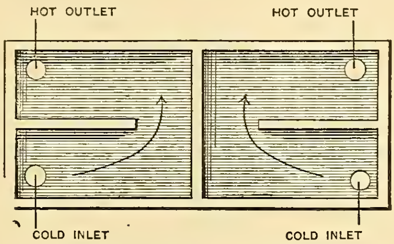


Fig. 1.—View Showing Construction.

one water back to be connected with the street service for supplying the fixtures within reach of the street pressure, the other water back being connected with a tank for supplying with hot water the fixtures connected with the tank service. My idea is to supply a five-story apartment house with hot water in the most economical manner regarding the consumption of coal and gas for the pumping engine, and more particularly to spare the tenants the great annoyance resulting from the frequent use of the pumping apparatus which would be necessary if the ordinary single water back heater is used, as the tank would have to provide a constant supply because of the quantity of hot water people are prone to use when supplied to them with the house. If I can procure such a heater and confine the tank supply to the upper floors I can dispense with the use of the pump, as the street pressure is sufficient to raise the water to fill the tank during the night, when very little water is being used in the city.

Answer.—Our correspondent being a New York plumber, we assume he is familiar with the use of a double boiler for the purpose

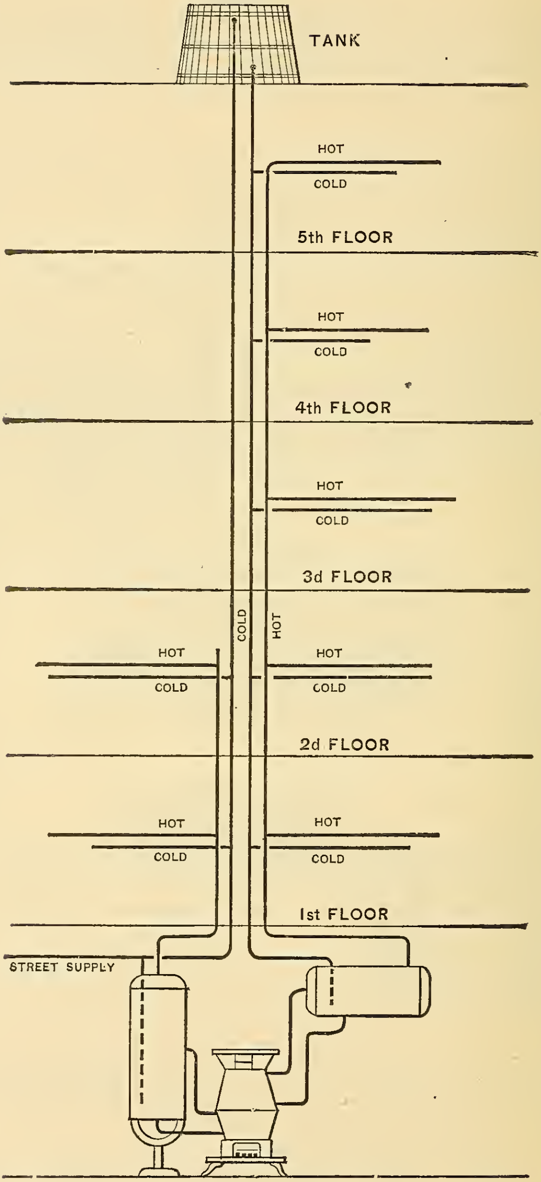


Fig. 2.—A Two-Section Water He ıConnected with Tank and Street Supplied Boilers.

which he mentions. The double boiler consists of an inner boiler immersed in the larger boiler, the larger boiler being connected with a water heating apparatus of sufficient size, the heat of the water in the outer boiler heating the water in the inner boiler. The inner boiler is supplied with cold water from a tank, the pressure from which forces the heated water up to the fixtures on the floors just below the tank, while the street service is sufficient to force the hot water from the outer boiler to the fixtures which it supplies when the faucets are opened.

The use of separate boilers has been resorted to in residences in parts of New York where the street pressure was not sufficient to raise the water to the higher floors, and in such instances a double water back, as shown in Fig. 1, having four openings, and so constructed as to make two complete water backs in one, has been manufactured specially for the work. If hot water is to be supplied to five different tenants it would be well to have in the basement a water heater with two separate water heating chambers. In order that this method of supplying hot water may be thoroughly understood by all of our readers we have prepared an illustration, given in Fig. 2, showing the method of connecting the apparatus. It will be seen that one boiler is connected with one section of the water heater and the service pipes run only to the lower floors, while a separate boiler is connected with the other section of the water heater and the service pipe is carried to supply the fixtures on the upper floors, the tank being shown on the roof above.

CHAPTER VI.

DIFFICULTIES MET WITH IN EVERY-DAY PRACTICE.

BOILER TOO LARGE.

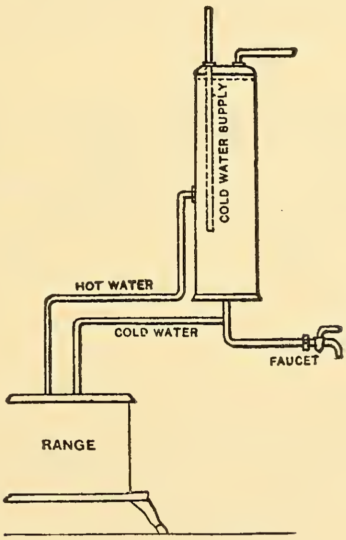
From S. E. K., *Ohio.*—I have connected a water front in a 7-inch portable range with an 80-gallon boiler, and since doing so the range works slow in baking and cooking and the boiler never becomes so hot in the lower portion that discomfort is felt from placing a hand upon it—in fact, near the bottom it is always cold. Sometimes the water drawn from the boiler is scalding hot, even when the boiler is cold at the bottom. There is no noise and the circulation seems to be easy, and though I put in a large boiler, so as to furnish plenty of hot water, my customer does not get enough and has to wait too long for it; besides, the stove works too slow and ashes accumulate very quickly against the water front. Where does the trouble lie and what shall I do to remove it?

Answer.—The boiler is too large for the fire, consequently the water keeps the water front cold, which chills the fire and makes it dead next to it for some space out into the fire chamber, and the air which passes through the dead coals cools the top of the range and the oven more than the remaining narrow strip of fire can overcome. This accounts for the slow operation of the stove. It is a common error to use boilers that are too large, with the idea of having an abundance of hot water, and the result is frequently a large quantity of water that is warm, but not hot enough to prove satisfactory. A small quantity of water such as our correspondent calls "scalding hot" may be mixed with a large quantity of cool water when warm water is needed, which shows that hot water is the most useful. The water in a small boiler can be quickly made hot and does not absorb so much heat from the fire as to interfere with the operation of the stove. To answer the questions put, the large boiler is the cause of the trouble. A 25-gallon or 4 foot by 12-inch boiler is a better size to use with the stove described, though some might prefer a 30-gallon boiler. If a water back, properly constructed so as to avoid air

and steam pockets, and a small boiler is used, set so that the bottom is above the water back, and the connections between them are made with large pipe, and one size larger pipe is used for the return pipe to the boiler, circulation will be free and there will be no noise. Small boilers will be found more satisfactory in the majority of cases for supplying hot water. Frequent attention to the fire to keep it bright and free from ashes when a large quantity of hot water is needed with a small boiler will enable it to supply it satisfactorily.

COLD WATER FROM A RANGE BOILER.

From H. & B., *Willsborough, N. Y.*—We have a range boiler in a house near here with a faucet on the cold water pipe at the bottom, the arrangement being as shown in the sketch which we inclose. What we want to know is



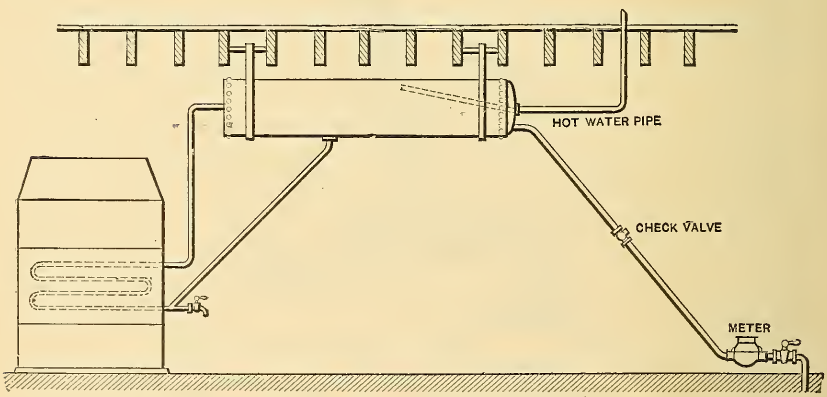
Cold Water from a Range Boiler.

why the faucet does not draw warm water. It will draw a pail half full of warm water and then the supply becomes cold. We understand that it is on the cold water pipe leading to the water back, but for all that, should not the water be more or less hot? We get hot water at the sink and bath-tub without trouble.

Answer.—The accompanying cut, made from our correspondents' sketch, shows the position of the faucet they speak of. The trouble they complain about is just what one would expect with the arrangement shown. On inspection it is evident that when the faucet is first opened the hot water in the lower part of the boiler runs out. Immediately, however, a fresh supply runs in through the cold water supply pipe shown in dotted lines, and, of course, fills the bottom of the boiler with cold water. This travels on a direct line to the faucet and consequently the after supply is cold. The hot water, being lighter, will fill the upper part of the boiler, but will not sensibly affect the temperature of the water in the lower part.

KEEPING HOT WATER OUT OF METER.

From J. O. G., *Battle Creek, Mich.*—Will *The Metal Worker* please advise me of the different methods now in use to prevent hot water from range boilers getting back into meters by expansion or by syphonage? I am quite familiar



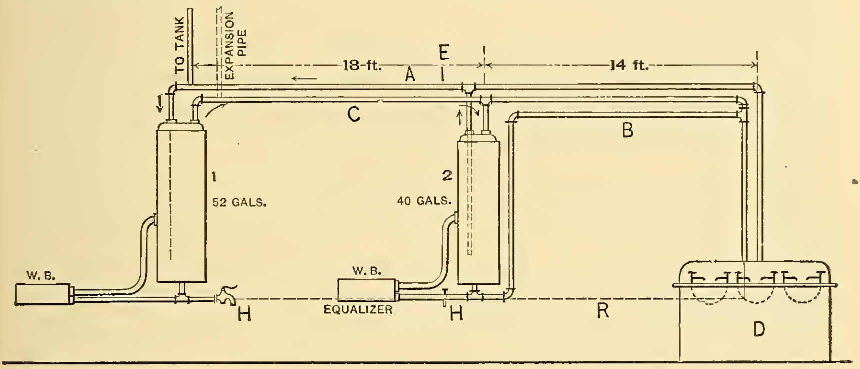
Keeping Hot Water Out of Meter.

with putting a hole in the conducting tube, but that will not always overcome the difficulty. Suppose the boiler be suspended from the cellar joists and connected with a coil in a furnace, as shown in the illustration. The regulations here require that a check valve shall be placed between the meter and the boiler, which I consider a dangerous practice, and as yet have never done it, as there would be no chance for expansion. Am I right? The meters here are easily spoiled by hot water, as the pistons are made of hard rubber.

Answer.—Some put a small notch or hole in the check valve to provide for the expansion, depending on the cool pipe and water to overcome the heating effect of the small quantity of water that passes through. It is probable that a safety valve, located so the overflow would be caught in some fixture, would answer every purpose.

LOCAL CIRCULATION BETWEEN TWO BOILERS.

From H. S.—I have a conundrum which I would like to submit to the readers of *The Metal Worker*—viz., Why does hot water flow from the cold water cocks at the wash basins, and continue so until about two pailfuls are



Local Circulation Between Two Boilers.

drawn, after which cold water will come? The two boilers are connected with two ranges, as shown in the drawing. One is 52 gallons and the other 40 gallons. The supply is from a tank in upper story. The horizontal pipes are straight from where they turn down to the basins to the furthest boiler and about 12 inches above boilers. There is fire in both ranges all the time. Pipes are ¾ inch diameter. I think I have found the cause of the trouble, and propose to remedy it by putting a check valve at E. Would it work? What other arrangement of the pipes would prevent the circulation? I find that after the cold water pipe is full of cold water circulation begins up the supply to the 40-gallon boiler and to the other boiler, as shown by arrows. Would not the circulation pipe make a suction on the hot water pipe from the 50-gallon boiler, and thereby cause this circulation?

Answer.—Our correspondent has asked a question which cannot be answered with certainty, inasmuch as the actual condition of all points concerned is not known. The condition of the fires has much to do with the circulation between the boilers, and the contrary

action of the currents may not always be in the same direction. Placing a check valve at E would undoubtedly stop the circulation as indicated by the arrows, but it would not remove the cause of the trouble. We are inclined to think that a more radical alteration of the work is needed. Boiler No. 2 being the smaller, becomes heated throughout first. As soon as circulation is established through the hot pipe of No. 2 and its circulating pipe, B, a current is induced through C ; then, as both boilers and pipes are full of water, none can enter boiler No. 1 from the tank ; consequently, the drain from boiler No. 1, caused by the forward current through hot pipe C, is supplied by a reverse current through cold supply A from boiler No. 2, the water passing up through the delivery of No. 2 and down through the delivery of No 1. This current keeps the 18 feet of cold supply A full of hot water and probably backs up some distance in the tank supply. This alone, however, does not account for two pailfuls of hot water issuing from the cold faucet. Opening the cold faucet gradually reverses the current through A. In the meantime, part of the water from the tank supply falls into boiler No. 1 by reason of its greater density, and maintains the current through C. The current through A being reversed, the flow up through delivery of boiler No. 2 is carried to the cold faucet instead of to boiler No. 1, as before. Thus, hot water issues from the cold faucet until the forward current through A is strong enough to prevent the cold water from dropping into boiler No. 1.

We suggest that an equalizing pipe be placed between the boilers as shown in the dotted line, having a stop cock in it, so that either boiler may be emptied independently of the other. Also that an expansion pipe be run up and over the tank, as shown also by dotted line in the sketch. By this means the overheated water will be relieved and any local circulation will be through the hot pipe C and the equalizer. We may here remark that if there are no other fixtures than those shown in the sketch, the heating surface is too large ; also that it is not usual to run a circulating pipe where the fixtures are so close to the boiler. However, if it is required, it would be better to cut out pipe B and continue the hot pipe direct from stand to the bottom of boiler No. 2, as shown by dotted line R in the sketch.

RUSTY WATER FROM RANGE BOILER.

From A. J. T., *Alexandria Bay, N. Y.*—I have been having some trouble with range boilers made of galvanized iron. They are 60-gallon boilers and are from four to six years old. They all give rusty, dirty water, no matter how well they are cleaned. All the boilers are supplied with rain water from a tin roof. Will you please inform me through *The Metal Worker* whether a copper boiler would remedy the difficulty or is the water front to blame? I have a suspicion that chemical action has taken place and eaten the boiler on the inside. A short time ago the galvanized nipple next to the water front sprung a leak (it was the hot water on the top side of the water front). After taking it out I found it all eaten through on one side its full length similar to a wormeaten piece of wood. The hot water evidently produced this corrosion.

Answer.—We have no doubt that the substitution of copper boilers in place of the galvanized boilers will stop the trouble from corrosion. Though galvanized boilers are used very largely for domestic hot water supply, sometimes they give rise to such trouble as our correspondent mentions. The fact is that as soon as the zinc is destroyed, which may happen soon after the boiler is put in place, when the galvanizing is poorly done, there is nothing to protect the iron against rapid corrosion. Iron is like lead in certain respects, for the purer the water the more rapid is the rusting, and, as our correspondent says, the supply in this case is rain water from a tin roof, or, in other words, the purest water that could be obtained. We do not think he is right in holding the water front altogether responsible for the rusty water, for it is made of cast iron, which is very little acted upon by either hot or cold water, and would not, under ordinary circumstances, give the rusty effect noted.

A REMEDY FOR NOISY BOILERS.

From L. D. N., *Washington, D. C.*—In visiting the kitchens of several private houses recently I have been very much struck by the number of cases (owing to the improper setting of the boiler, the undue size of the water back or some other adequate cause) in which the boiler makes a tremendous noise—rattling and rumbling. It seems to me that this is a defect that could be easily overcome if the manufacturers and plumbers would give some little heed to it, and there is no doubt that it would be very much appreciated by the average householder, the terrific racket in his kitchen being more

than an ordinary nuisance. The number of cases, however, where the pipes connecting the water back and boiler are sagged or run so as to form traps is very great, and the size of the pipes is often very small. In the first place, I want to know what is the objection to setting the boiler above the water back so that the bottom of the boiler would be higher than the top of the water back? In that way there can be an easy incline for both of the pipes. Another question I have to ask of the manufacturers and plumbers who are interested in such work is, What object is gained by making the circulating pipe so small? What harm is there in using 2 or 2½ inch pipe? Will it not, in fact, give a much better job? It will reduce the friction in the pipes and ought, I think, to give better results in heating the water. The extra cost for the larger size of such a short length of pipe would not be very great, and the customer would in many cases be glad to pay the difference if he were assured of a better supply of hot water, and more especially if it would assist in reducing the noise. The second is a point for the plumber to consider, after the manufacturer has made arrangements for connections of the larger size, but the first point—namely, the hight and size of the boiler—comes entirely within the province of the manufacturer. A shorter boiler of larger diameter would furthermore have less radiating surface to the volume of water. The public are growing very critical of work, and imperfections that were put up with ten years ago must now be overcome or serious complaints will follow.

CRACKLING IN RANGE BOILER.

From C. & W., *Berrien Springs, Mich.*—Will the editor please give through the columns of *The Metal Worker* the cause of a loud roaring or crackling in a range boiler, and how to remedy it?

Answer.—The noises proceeding from the boiler are probably caused by a defective circulation, which may be owing to the deposit of sediment in the water back, or a trap in the pipes between range and boiler. The remedy will be found in a removal of the impediment or a rearrangement of the pipes which will give a free circulation. If the trouble is due to the boiling of the water it can be stopped for a time by drawing off some of the hot water and letting the boiler fill up with cold water. A permanent remedy is

sometimes effected by placing fire brick in front of the water back, and thus reducing the area of the heating surface.

NOISE IN BOILER AND PIPES.

From F. R. M., *Warrensburg, N. Y.*—Will you kindly inform me through the Letter Box the cause of a jarring, rumbling noise in pipes and boiler which starts upon opening a hot water faucet in any part of the house? The noise can be heard all over the house, no matter in which room the faucet is opened, and sounds as though the pipes and boiler would be torn to pieces. The boiler holds 32 gallons and the pipes are ¾ inch.

Answer.—The trouble in question is probably due to one of two causes. Where there is a strong water pressure, oftentimes on closing the water faucet quickly, the jar is transmitted to the fixtures with such force as to cause a trembling and a rattling, as described. Another cause is due to the generation of steam where the pressure of water to supply the boiler is very light, which allows steam to accumulate at the top of the boiler, in the water back and in the circulating pipe. Immediately on the opening of the hot water faucet, cold water rushes into the boiler to take its place, and the steam that may be at the top of the boiler is at once cooled and condensed, leaving a vacuum, which is filled by a rush of cold water, and where the water meets the result is very similar to bringing a hammer down upon an anvil with the same force. Condensation and vacuum may be formed in the return pipe from the water back, or in the water back, by the steam coming in contact with a cold part of the pipe or cold water entering the water back.

NOISE IN BOILER.

From B. & S., *Napanee, Ont.*—We have recently set up a 50-gallon copper boiler and connected it with a range in the ordinary way with ¾-inch pipe, the tubing outside of range boiler being about ½ inch. The connections to boiler are of lead pipe with nipples or connections for ¾-inch pipe. Our customer, who is great on having large pipe, thinks that the lead pipe, being a trifle smaller than the connections, causes the boiler to creak. We thought at one time it was on account of his not using enough water from the boiler. The minute the hot water tap was opened the noise ceased. We have tried cooling the water, but it does not make any difference, and some days it is quiet. It seems when it does make the noise that it has the motion of the water works pump. If *The Metal Worker* can furnish us with any information that will lead to a remedy it will be appreciated.

Answer.—Too little description is given of the trouble to locate its cause and suggest a remedy. But from the fact that the noise ceases when the hot water tap is opened, it may be due to a loose part in some of the connections which vibrates under pressure and makes the noise, which stops at times when the part is temporarily secured or when the pressure is removed by opening the faucet. A projecting washer or some irregularity of form in some part would impede the circulation or cause an eddy that would produce noise. A dip or partial obstruction in pipe from a bad joint, causing an air trap, has been known to give rise to rumbling. It is bad practice to use a pipe with smaller bore than the connections in connecting the boiler and water back. Benefit is derived from using a larger pipe for the return to the boiler. If the heated water cannot flow to the boiler as soon as it is heated, steam is likely to form in the water back, making noise when it condenses. Some minor detail of the work will, on careful examination, probably be found to be different from what it should be.

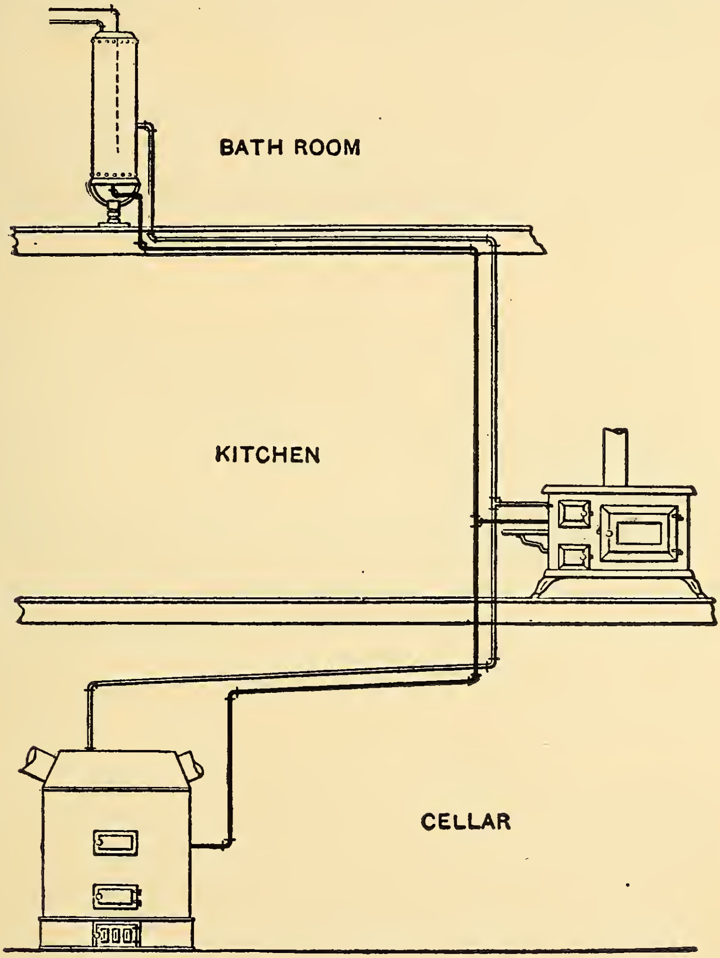
NOISY HOT WATER FAUCET.

From O. H. T., *Leechburg, Pa.*—I have just completed a job of plumbing, and am now in need of some information as to why the hot water faucet makes a rumbling noise when it is opened partially. When opened full there is no noise. Is it vacuum? If so, what is the remedy for the trouble? If not vacuum, what can the trouble be?

Answer.—Vacuum has nothing whatever to do with the trouble referred to by our correspondent. The rumbling noise is caused by some defect in the faucet; whether in principle or carelessness in construction we cannot say. However, from past experience, we are inclined to believe that the noise is caused by a loose washer or lack of stability in the stem. Perhaps some irregularity in the interior surface of the ferrule of the faucet causes the water to "eddy" just prior to its passing the washer, and thereby causes the rattling. If the faucet is one of the lever-handle pattern, operated by an eccentric stem, the noise may be the result of the absence of a guide for the washer shaft. The lack of this guide is most apparent in faucets with very short ferrules. In case our correspondent fails to locate the cause of the noise, we advise him to compare the faucet with another of the same type in use under similar conditions and giving satisfaction. By noting wherein they differ, a solution of the problem may be reached, in case our hints are of no avail.

REVERSED CIRCULATION.

From H. R., *Pottstown, Pa.*—Having seen many knotty questions in *The Metal Worker*, I send you herewith a sketch of one that beats the best. A party



Reversed Circulation.

had a range connected to a circulating boiler in the usual manner, which worked all right but did not give as much hot water as was needed. He therefore ran a pipe through the heater in the cellar, being careful to give it the proper eleva-

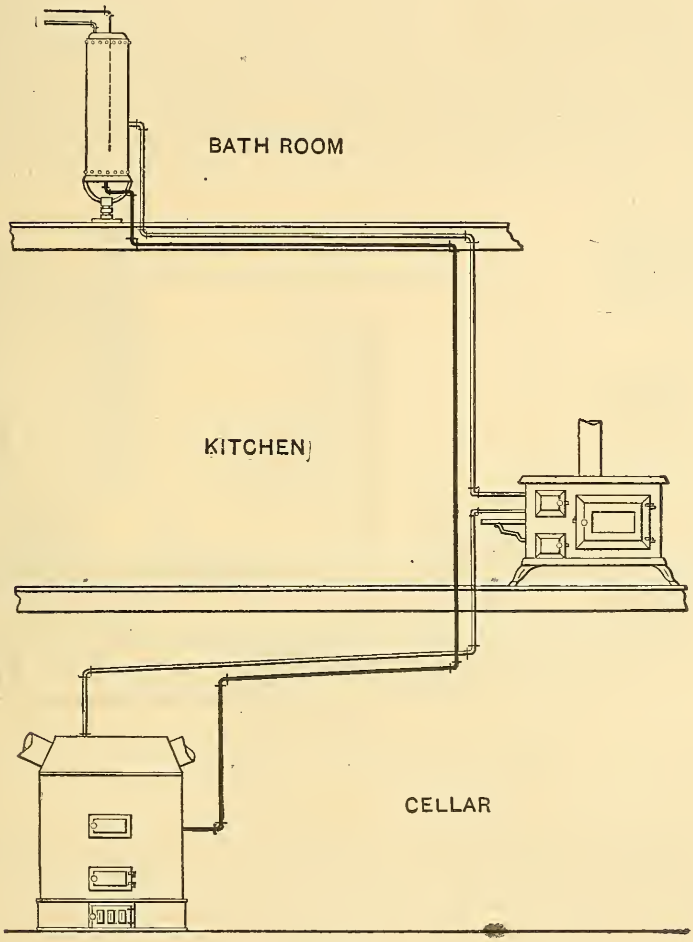
tion as it passed over the fire, then continued the flow and return pipes back and connected them at the range, as shown in the sketch. Each one works splendidly independently of the other or if the water coming from the range is the warmer, but when the fire in range is reduced the circulation is reversed between the range and the boiler. The hot water enters the bottom of boiler and returns from the side, and continues to circulate in that manner until the fire is again increased, when the proper circulation is again established. What causes this and what is the remedy ?

Note.—We submit this case to the consideration of our readers. From the statement that the circulation is natural with either singly there seems little cause for the unusual change, and no room is left for the supposition that the flow pipe was connected with the bottom of the coil, which otherwise might account for the reversing.

From S. H. D., *Watkins, N. Y.*—I notice the article of "H. R." on "Reversed Circulation." Instead of attempting to give a reason for what is said to occur, I beg leave to doubt the statement. If the circulation is reversed between boiler and range it must stop between the heater and boiler or run both ways in the same pipe, which is an absurdity. More likely the circulation occurs between the heater through water front as well as through the boiler. In that case the lower pipe from water front would be about as warm as the upper pipe to front. I suppose there are no other pipes than those shown in diagram of the p ping. If "H. R." will place a swinging check valve in the lower pipe from water front of range, so the water cannot enter that way, but can come out freely, he can settle the question.

From G. W. M., *Waynesboro, Pa.*—In reference to the difficulty of "H. R.," the circulation takes the near cut instead of the course offering the greatest resistance. After drawing the fire in the range the circulation continues through the range coil, which completes the short circuit, the temperature gradually falling in the boiler, as only a portion of the flow goes to the fire below. A valve in either pipe to the range will remedy the d'fficulty. A system arranged as shown by "H. R.' will always work slow and finally reverse and go the wrong way, when it can never heat satisfactorily. I hope I have thrown some light on the subject that will be a ben fit to the readers of your interesting, valuable and reliable paper

From W. H. C., *Rahway, N. J.*—In answer to the query of "H. R." I would say the connections are made improperly. If the piping

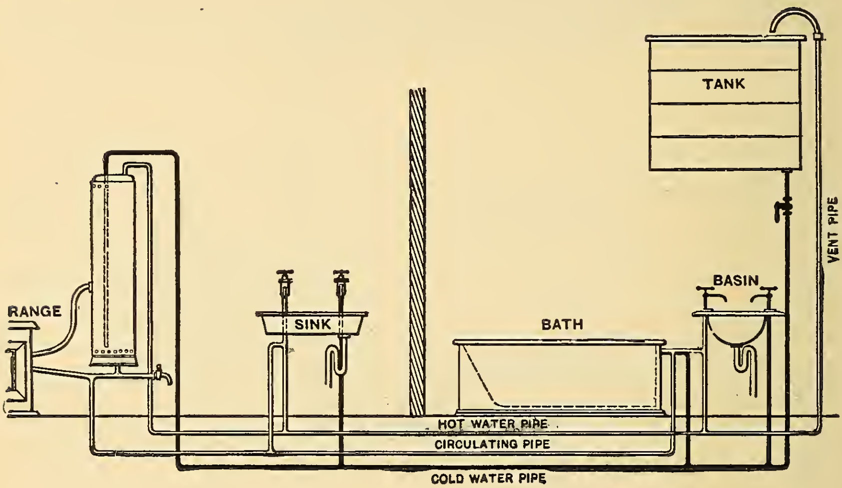


Reversed Circulation.

is changed so that the circulation will be continuous there will be no reversed circulation. I send a diagram showing how the water can be made to circulate without any possibility of its backing up.

RANGE BOILER EMPTIED THROUGH RELIEF PIPE.

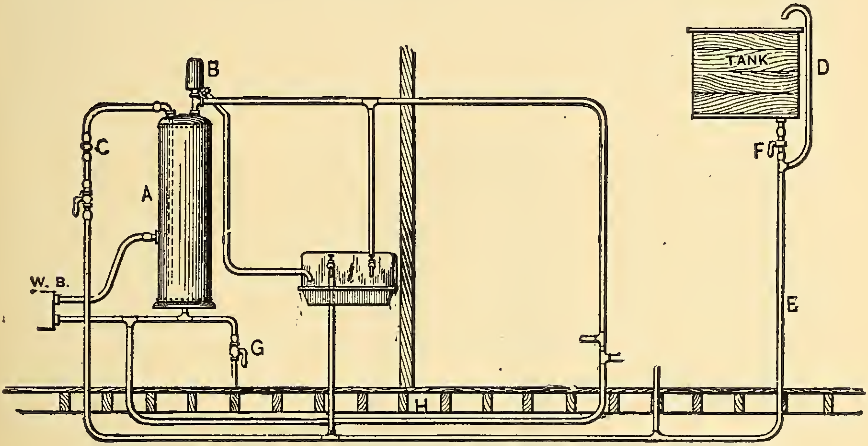
From C. Q. A., *Ohio.*—I inclose drawing of work that has given me considerable trouble, and I wish to have some assistance from the trade. As soon as the boiler fills up with water it will siphon back into the supply tank through the vent pipe. The work is all on the second floor, with pipes running under the floor and as nearly level as they can be put. The water is all supplied with the tank



Range Boiler Emptied through Relief Pipe.

pressure, the bottom of the tank being on a level with the boiler. The capacity of the tank is 27 barrels, and it makes no difference whether the tank is filled or only two-thirds full, the action will be the same. You will see that the circulation pipe is branched into the hot water pipe, both at the sink and wash basin ; also into the bottom pipe leading from the boiler to the stove. The pipe conducting the water from the top of the boiler to a point within 12 inches of the bottom has a hole in it near the top. The stove water back is at the side, as shown. We had no trouble in heating the water. The piping is all of ⅝-inch lead pipe. The water siphons when it is hot.

From S. I. D., *Canada.*—I have noticed that "C. Q. A." is in trouble. I send herewith a sketch showing a method of arranging his pipes that will obviate his difficulty, which is what he calls "siphoning" of the water in the range boiler back into the tank through the vent turned over top of tank. This, however, is a misapplication of the term "siphoning." The reason for the water flowing back into the tank through the vent is because of pressure in the range boiler becoming greater than the head of water in tank,



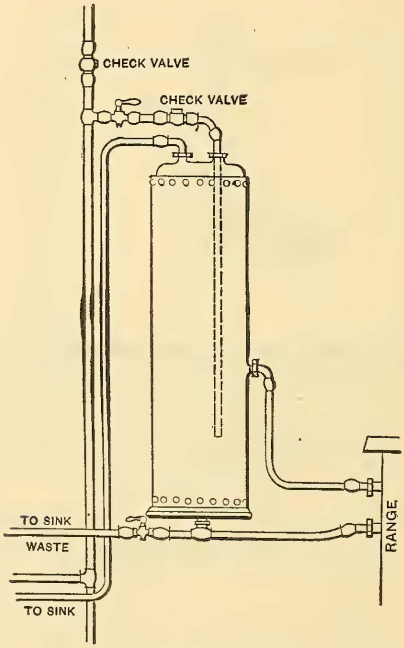
Range Boiler Emptied through Relief Pipe.

due to particles of steam mixed with water trying to escape, and which naturally find an outlet at the vent. Referring to the sketch herewith, A is the range boiler, B is a combination safety and vacuum valve (a small tube is generally run from this over kitchen sink), C is a check valve to prevent any water backing up into the tank. If this boiler were connected with city pressure water works the check would not be needed. The pipe D allows the water to drain out of the pipe E when the stop F is closed ; G is a blow off to sewer. It will not be necessary in this case to have a small hole drilled in tube running down inside of boiler, as the check C will prevent siphoning. H is the circulating pipe, which allows hot water to be drawn from fixtures immediately. Some of the pipes are shown running beneath the floor, but it should be avoided where practicable. It is much better to have all pipes exposed. They can be finished nicely in

white and bronze so they will not be at all unsightly, and it will materially lessen the plumbers' bills for repair work, as pipes are often almost inaccessible when placed beneath floors or within partitions, &c.

WATER BACKS BURST REPEATEDLY.

From T. J. K., *Brooklyn, N. Y.*—About four years ago I set nine ranges in three three-story single flat houses in this city, which were connected to boilers,



Water Backs Burst Repeatedly.

&c., by a plumber engaged by the owner of the building. The ranges were in use about six months when one of the water backs burst, cut clean in two, and breaking the end of the range. I put in a new end and water back, and about two months after the same back burst again. One year after another burst, and last week, nearly four years later, another one, all being on the middle floor. I claim it is due to some fault of the plumbing, but to satisfy the owner, who thinks the fault is with the water back, I refer the question to you. I send you a sketch of the range, boiler and connections. The cold water supply runs from

the main in the cellar in a single line to the top floor, which is the third story. On the second floor in each house there is a check valve in the cold water branch, between the stop cock and the boiler, and on the top floors the valve is in the main line, about 24 inches above the sinks. When the houses were finished it was found that there was not enough pressure at times to force water to the top floors, so a pump was put in on the top floor of each house, and a check valve put on the main line on the second floors above the boiler, to prevent, as the plumber said, the family on the top floor from drawing water from the boiler on the second floor. About one month after the pumps were put in there was a new main laid in the street, and they now have pressure enough and do not use the pumps. But the check valves were not removed and are still in the pipes. The plumbing work is the same on each floor, except that there are no check valves on the first floor. The water backs that burst were on the second floor and did not burst with any great force, such as would occur if the supply pipe were frozen, but simply split in two, breaking the end of the range next to the back.

Answer.—We agree with our correspondent that the arrangement of the plumbing work has more to do with the bursting of the water backs than a lack of strength in the water backs themselves. Steam is the probable cause of the water backs bursting in the case mentioned. If it were the direct cause the explosion would have been with such force as to make the results disastrous. We are inclined to think that there was a cessation in the supply of water to the water back, or if not an entire cessation, a very greatly reduced pressure. Under such circumstances steam would generate in the water back to a greater or less extent. The condensation of this steam would create a vacuum and the inrush of water filling the space would strike a blow, the force of which has not been accurately determined to the satisfaction of engineers who have considered the subject, but is sufficient to split a water back. The arrangement of the check valve and stop cock so close together at the top of the boiler would naturally reduce the size of the waterway and increase the friction at that point. Any generation of steam in the water back would create a back pressure, which would close the check valve and stop the supply for the time being. If the stop cock were located at a different point, so as not to reduce the waterway, and the check valve entirely removed, we think a material relief would be given. If the stop cock must be placed at this point, one should be used which will give a waterway the full size of the bore of the water pipe.

From F. K., *Bound Brook, N. J.*—Having read about the bursting of water backs in Brooklyn, I would like to ask if it was not partly due to the check valve

in the cold supply of the boiler, and should not the supply pipe always be open to act as a safety valve?

Answer.—Without the check valve, in case of steam forming in the water back, the pressure would work against the street pressure and take care of the expansion of the water. With the check valve preventing relief from the back pressure, due to the expansion of the water, the strength of the fixtures would be tested. In this expansion of the water on being heated might be found another cause for the bursting of the water back. In case of the fire having gone out and all the fixtures being filled with cold water and a fire then started, any back pressure due to the expansion of the water would close the check valve, and the expansion might be sufficient to burst the water back as reported if it chanced to be the weakest part of the system.

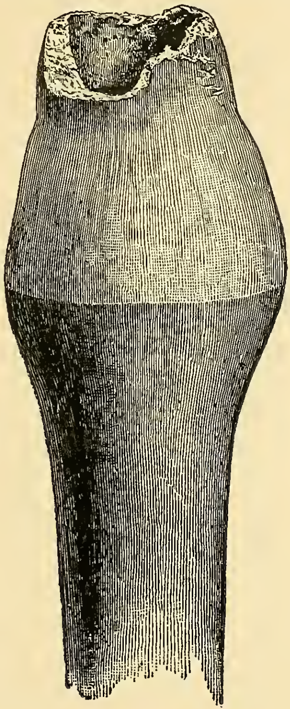
WHAT CAUSED THE EXPLOSION?

From C. I. L., *New Jersey*.—Please inform me what caused the explosion which I describe. When a summer residence here was closed, all the water was drawn out of the pipes and the water shut off to prevent freezing. Recently a servant was sent to prepare for a short visit by the family, and built a fire in the range, and later on when some water was needed it was turned on by opening a stop cock in the front cellar, but before the servant reached the kitchen a terrific explosion occurred. The water back was thrown out through a window 50 feet across a garden, the brick jamb at one side of the range was torn away, the range was demolished, the ceiling was shattered, the windows were broken, and coals were thrown all about the kitchen. A fire was prevented by the broken pipes sending water in every direction. I was called in to make the repairs, and would like to know what made the trouble.

Answer.—The explosion was caused by water entering a water back that was possibly red hot, when steam was instantly made of such great expansive power that it not only burst the water back, but spread everything that tended to confine it. To use a fire against a water back that has no water in it is likely to crack the water back through expansion or melt the solder on the pipe connections, or make leaky joints when iron pipe is used. To turn the water into a water back lying in a good hot fire is always extremely dangerous, and some severe personal injuries and wreck of property have resulted from doing it.

WATER HAMMER IN BOILER CONNECTION.

The subject of the illustration was furnished by John Gormly, Philadelphia, and represents a piece of pipe which was taken from a job where he was called to make some repairs. The broken end shows the solder in a joint that was wiped on the side connection to



Water Hammer in Boiler Connection.

a kitchen boiler, and which was swelled and broken, Mr. Gormly states, by water hammer. The enlargement is very uniform, there being no special swelling in one side, as is usually the case, and it will be noticed that the solder has stretched quite as much as the pipe. The pipe is very heavy, ¾-inch pipe, which shows the power of the concussions which finally broke the joint, after a leak which occurred in the swelled part had been stopped by hammering metal into the opening. To those who are not acquainted with water ham-

mer it is explained as being due to steam that has formed in the water back passing to a point where it condenses, creating a vacuum which is filled by an inrush of water that strikes with a much greater force than is generally appreciated. When a water back is large and steam is generated freely this striking is frequent and the result is as shown. A larger opening or a water way of the full size of the pipe through the side connection would carry the steam into the boiler before it condensed.

SWELLED BOILER PIPING.

From E. H., *Nyack.*—A number of years ago I was called upon to repair the hot water pipe from a water back to a boiler. I found the boiler to have an open top with loose cover. Into this boiler the water was pumped as it became empty. The pipe close to the joint where the heavy lead pipe was wiped on the brass nipple at the side of the boiler was swelled to fully double the size of the other pipe, and had opened just enough to make a very small leak. The owner told me it had done so before, and wished me to make a new joint. I accordingly repaired it, but suggested that probably only an iron pipe would be a permanent remedy. About two weeks after I was called to replace the lead pipe with iron, as it had again given out. It has now been in use about five years with no further trouble. I would like to know if this is a common occurrence with such boilers, or is it owing to some local circumstance in this case?

Last fall I was called for the first time to a boiler which was supplied by pressure, not very heavy. In this case the lead pipe from water back to boiler had been swelled out of all proportion and been repeatedly mended next to the water back connection. It was leaking and I mended it as it had been mended before. In this case the break was through the solder, which seemed to have been almost as thick as the pipe. In a few weeks' time I replaced this with iron pipe, as another leak showed itself. We have had no further trouble. One more case was somewhat similar, only in this the pipe gave out next the boiler, and after several times repairing I substituted iron pipe, which remedied the difficulty. These troubles all doubtless arise from imperfect circulation, but why should they act so differently? I thought it might come from the boiler tube being so short that the cold water is discharged so close to the inlet for hot water as to cause it to damage this pipe every time. If such is the fact it becomes a very important matter to see that this tube extends well toward the bottom of the boiler.

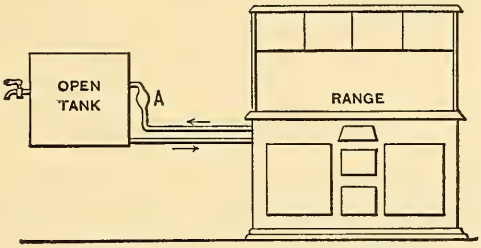
Answer.—The swelling of the return pipe to the boiler is a quite common occurrence, and happens when the water back has a large heating capacity and when the water pressure is very light, as is stated in the cases reported. It is not due to the tube in the boiler or any unusual local condition. It is caused by steam forming in the water back and passing to some point where condensation is effected as the result of the delay in passing some slight obstruction.

On condensation there is a vacuum that is instantly filled with a rush of water which has the effect of striking a blow and is known as water hammer.

BURST CIRCULATION PIPE.

From G. F. B., *Du Quoin, Ill.*—We recently piped a range with open tank for heating water as shown in the accompanying sketch, using 1-inch heavy lead pipe. A day or two since one of the connections puffed out as large as a man's fist at A. We would like to know the reason for it.

Answer.—From the sketch we would judge that the water back in the range had a very strong heating capacity ; much greater than



Burst Circulation Pipe.

was required to heat the water in the tank. As a result steam formed in the water back, and passed along the circulation pipe until it struck the fitting by which the lead pipe was connected with the tank. Here it met a reduction in the size of the water way. The steam at this point condensed and water rushed along to fill the space, delivering a blow at the point where the condensation took place. Numerous repetitions caused the pipe to swell until finally it burst. This is not an unusual happening. A recurrence can be prevented by the use of iron or brass pipe. Brass pipe is preferable because it does not rust fast, but can be disconnected when desirable.

CHAPTER VII.

RELIEF PIPES AND VACUUM VALVES.

The use of relief pipes and vacuum valves is not general, but is adopted sometimes where the supply pressure is low or from a tank to provide for the expansion of the water or the escape of air or steam. They also permit air to enter the boiler to prevent the formation of a vacuum when the boiler is emptied of water by siphonage or by the condensation of steam. The proper place to connect the valve or relief pipe is at the top of the boiler, but if the hot water pipe rises direct from the top of the boiler without any dip the relief pipe may be connected at the highest point and run up above the level of the water supply.

COLLAPSING BOILER.

From F. H. K., *Watsontown, Pa.*—One of my customers has in his house a 30-gallon circulating boiler made of copper. The other day he had occasion to turn off the water in order to repair a faucet. The boiler collapsed with the water in it, but adjusted itself as soon as the pressure was turned on again. What is the cause of the action and how can it be remedied?

Answer.—The shell of copper range boilers is very thin and often too frail to withstand the atmospheric pressure without the aid of some internal pressure; therefore, if the water be shut off by a stop and waste cock and no provision is made for admitting air in the top of the boiler, it will be subjected to external pressure when the waste is opened. The pressure of the atmosphere at ordinary levels is about 14 pounds per square inch, which is more than enough to crush the common type of copper range boiler. When the returning water pressure is great enough it will expand the boiler and sometimes leave it but little worse from such an experience. If the pressure from the water main is not great enough, a hand force pump will serve to expand the boiler into its proper shape again. Our correspondent is mistaken in his belief that the boiler collapsed while it was filled with water; such an action is impossible.

There are several methods of preventing boilers from collapsing. In tank jobs, the relief pipe direct to the tank from the top of the

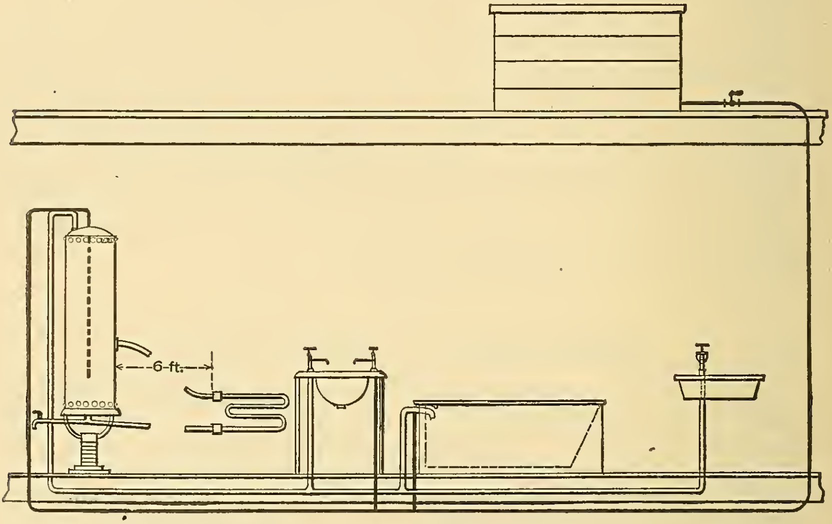
boiler is the best way. In direct pressure systems, automatic vacuum valves of various forms are used, and when properly constructed they are good. The usual way, however, is by opening the hot water faucet over the sink or some other convenient fixture to admit air. Care should be taken to see that the pipe opened to admit the air to the top of the boiler is not trapped, as traps interfere with the passage of the air and sometimes frustrate the object of opening the faucet altogether. Of course this latter method is worthless as far as keeping the boiler from emptying is concerned, unless the "siphon hole" is open. The siphon hole is a small hole drilled in the delivery pipe inside the boiler, near the top; the delivery pipe being carried down to near the bottom to prevent cooling the hot water with the delivery. When the stop and waste cock is turned off, the water siphons out to the level of the siphon hole; at that point air enters and breaks the siphonic action; that is, if the hot water faucet has been opened to admit the air. If not, the siphonage continues until the boiler is empty.

WHAT CAUSED THE COLLAPSE?

From H. D., *New York.*—I recently set a range boiler which collapsed 18 hours after water was turned on and would like *The Metal Worker* to explain what caused the accident. The boiler was a 40-gallon light weight copper boiler. Cold water was supplied by a ¾-inch lead pipe from a tank in the attic, the pipe running from tank to cellar and across underneath bathroom floor and tapped there to supply cold water to the bathtub and wash basin, as shown in the sketch. The boiler is in the corner of the bathroom and the supply pipe came up through the floor and connected to the center connection on top of the boiler in the usual way, with the tube inside of the boiler running down to within a short distance of the bottom of the boiler. The hot water pipe was connected to the top of the boiler in the usual way—to the coupling, about 4 inches from center. The boiler was connected by ¾-inch pipes to a double pipe water front. From the stove to the boiler is about 6 feet. The boiler was full of water when it collapsed, as the parties had been drawing hot water from the faucet in the kitchen shortly before it occurred. A rumbling noise was heard in the boiler a while before it collapsed. A natural gas fire, very hot, was burning in the stove and the water front is very close to the burner. The boiler, instead of being bulged out, as usually occurs when an explosion takes place, was drawn in all around the top just below where the top is riveted to the body, and looked as if a rope had been put around it and forcibly tightened up until it caved in. The boiler was full of very hot water, which spurted out of the hole made by the collapse. The top of the boiler sagged down with such force as to tear the lath from the wall where the tacks were screwed to them. The boiler must have been quite hot, for the color of the copper is changed at the top or the hottest part. I inclose a sketch showing the location of the fixtures. I am at a loss to tell what caused the accident, as I never saw anything like it in 13 years' experience, and

am blamed by the customer for whom I did the work. The order for the range boiler and connections was filled by a traveling man, who is a plumber, he knowing what the parties wanted.

Note.—It is quite possible the collapse was caused by steam in the boiler due to great heating capacity of the pipe water front and lack of pressure in the supply. From the top of the boiler to the level of the water in the tank, as shown in the illustration, would hardly be



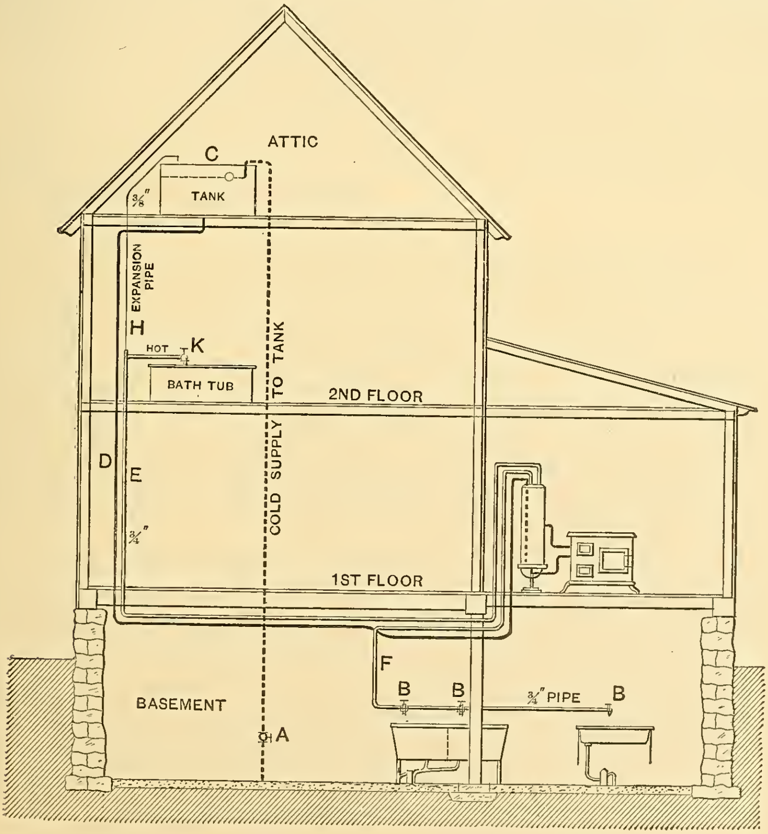
What Caused the Collapse?

over 6 feet. Using the thumb rule of water pressure of ½ pound to each foot in hight, a pressure of only 3 pounds would be exerted at the top of the boiler by the supply. The large water heating surface exposed by the construction of the water front would enable steam to be generated freely and passed to the boiler. The accumulation of steam at the top of the boiler would drive the light pressure water supply back to the tank and would discolor the copper, as mentioned. Drawing off hot water at any faucet would let cooler water enter the boiler and pass to the water back, when the generation of steam would be stopped and the steam from the boiler would follow along the hot water service pipe, both actions tending to condense the steam and create a vacuum. If the vacuum was of considerable size it would not be filled with water before the atmospheric pressure of about 14 pounds to the square inch on the surface of the light cop-

per boiler would cave it in. The trouble can be avoided in future by placing a vacuum valve at the top of the boiler to let in air when necessary or by running a relief pipe from the top of the boiler to the top of the tank and turning the end over the tank, but not into the water. This would let the steam escape and remove the cause of the collapse. Such experience is not unusual where the water pressure is no greater than it would be with a tank placed so little above the top of the boiler.

TO PREVENT COLLAPSE OF BOILER.

From T. L., *Natick, Mass.*—Will *The Metal Worker* please give me information as to the result of the conditions shown by the sketch? Cold water



To Prevent Collapse of Boiler.

supply at A cut off, all the bibbs in the bathroom K closed, and the bibbs B, B, B on the hot water pipe in the laundry open. From the top of the hot water pipe in the bathroom a ⅜-inch pipe is carried to the supply tank. Will the supply of air through the ⅜-inch expansion pipe be sufficient to prevent a partial collapse of the boiler?

Note.—It is possible that a ⅜-inch pipe would prevent the boiler from collapsing, but a safer practice is to use a larger size. A ½-inch pipe is used by many experienced plumbers, though some observe a rule of making this pipe the full size of the pipe which leads from the boiler, and others use a vacuum valve at the top of boiler. When the hot water pipe makes a dip as shown, the relief pipe should run without descent direct from the top of the boiler to the tank. The pipe run as shown would permit the water to expand freely, but the water that would collect in the dip would prevent the escape of steam or the immediate entrance of air.

CHAPTER VIII.

HORIZONTAL BOILERS.

When boilers are set horizontally great care should be taken to provide for free circulation, for the tendency toward circulation is not so great in this style as in an ordinary vertical boiler. The use of horizontal boilers has become general with a class of ranges designed for limited space, and they have proved very satisfactory. In some cases an upright boiler has been set horizontally with good results, but as a rule, a specially made horizontal boiler is used. The openings into these special boilers vary with the different manufacturers. Some have all four openings in one end. Others have two openings for the water back connections in one end, with the cold water supply and the hot water outlet on the side of the boiler which becomes the top when set.

AN UPRIGHT BOILER SET HORIZONTALLY.

From J. H., *New Orleans, La.*—I have a problem in some boiler and range connections, and would thank you for information concerning them. The boiler had to be placed in a horizontal position on account of the supply coming from a cistern. The work, as it is, does not seem to give satisfaction. The boiler only gets hot on top, although there is plenty of heating surface in the stove. I send you a sketch of the work in question, Fig. 1; the boiler is on the same level with the sink and bathtub. I also send a sketch, Fig. 2, showing the way I have been in the habit of doing similar work, which did give satisfaction. The boiler is galvanized and there is no danger of it collapsing.

Answer.—We suppose that, as is the case with many Southern homes, the cistern referred to by our correspondent is simply a tank or reservoir, of some type or other, placed above the ground, and, being near the ground in order to secure a stable support, it was necessary to place the boiler in the position mentioned in order to take advantage of the pressure it afforded. We have made engravings from the sketches furnished us by our correspondent, as will be seen by Figs. 1 and 2.

By studying the cuts it will be seen that Fig. 2 has more than

one advantage over Fig. 1, yet the advantages in practice would fall short of expectation by reason of counter effects, which do not exist in Fig. 1, having to be neutralized. For instance, the water above the dotted lines drawn through the boilers in the sketches would circulate through the water pipes leading to the water back, while that below the dotted lines would be dormant on account of its greater specific gravity. And although the heating capacity of the boiler placed as shown in Fig. 2 would be much greater than if placed as in Fig. 1, the ability to draw more than a certain amount of hot water at once would be interfered with by the cold water discharging into the hot water.

In Fig. 1 the cold water is delivered into the dead water in the

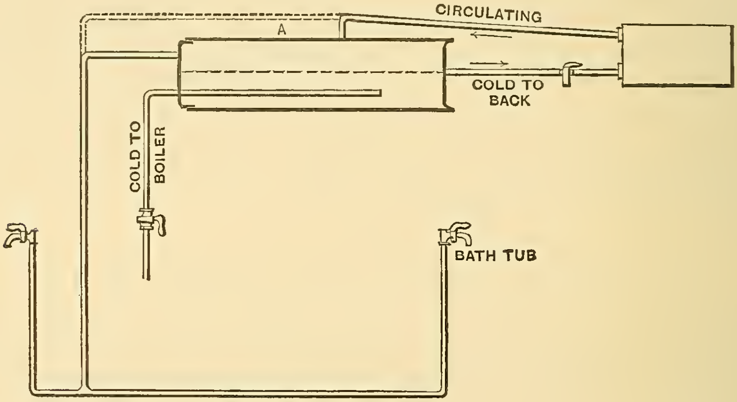


Fig. 1.—Present Arrangement of Boiler.

boiler and does not disturb the hot water, but the hot water space is so limited by the position of the lower circulating pipe to water back that only a small amount of hot water could be drawn at once. With the connections as shown in Fig. 1, we fail to see how the water can get warm at all, as a "pocket" of air would invariably be caught in the circulating pipe returning from the water back. The air would prevent the pipe from filling with water and circulation would be impossible under such circumstances. Granting that some provision has been made for removing the air from the upper circulating pipe and that the water will flow, it would still be impossible to draw more than a small amount of water at a medium

temperature at one time. The water above the hot water outlet would be kept there by the same law which causes circulation. Likewise, the water below the lower water back connection would remain stationary, except when disturbed by the incoming cold water; this leaves only the layer of warm water between the hot outlet and the lower range connection level for service at a single drawing. Considering all things, the arrangement shown in Fig. 2 seems to be much the better. However, the maximum heating power cannot be developed in either boiler without a radical change in the connections.

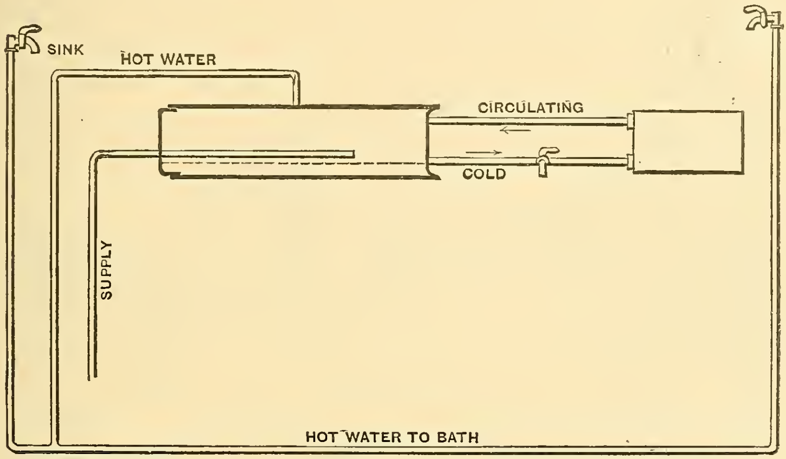


Fig. 2.—Arrangement Proposed by "J. H."

As a system of the kind shown in Fig. 1 is causing the trouble complained of by our correspondent, we suggest that for temporary relief the hot water pipe be connected to the range circulating pipe, as shown by the dotted line A; then hot water will be obtained as soon as the fire is kindled and all the hot water above the point shown by the dotted line in the sketch can be drawn at one time; also, the accumulation of air before mentioned would be avoided—that is, assuming that the hot pipe is connected at the highest point on the circulating pipe, which should be at the point indicated on the sketch.

A HORIZONTALLY SET BOILER.

From A READER, *Nashville, Tenn.*—Inasmuch as horizontal positions for range boilers are only sometimes necessary, and boilers used on such occasions are usually designed for that particular position, I feel at liberty to presume that examples of the ordinary vertical range boiler set in a horizontal position are a rarity. Having just completed a job of setting and adapting the connections of

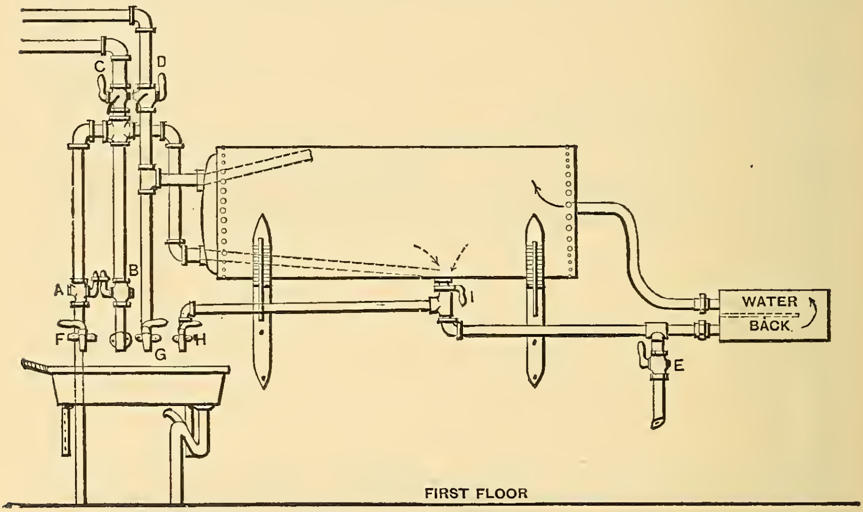


Fig. 1.—Method of Setting Boiler.

an ordinary boiler to a horizontal position, and finding the work to be a flattering success, I forward a sketch showing the manner in which the work was done, hoping it will be of interest to at least a recent inquirer who wrote to *The Metal Worker* from New Orleans. I have, from time to time in the past, set ordinary boilers in several different ways—that is, with the ends reversed from that shown in Fig. 1; also with the side opening at the top instead of at the bottom, as here shown. Each of my former settings had some particular feature which at first seemed to be desirable, but in practice there was invariably some counter influence which destroyed the effect of the good point. For universal satisfaction and general absence of undesirable features, the setting in question seems to

take the lead ; at least, it does in my experience. All of the former settings of this character were more in the nature of experiments than of endeavors to conform to the requirements of the cases. In this case, however, it was a necessity which caused me to place the boiler as it is. The owner desired to utilize the natural head of a spring near the house and the spring level was too low to admit of the boiler being placed on the end. The bathroom fixtures are on the same floor with the boiler and range, the bathroom floor being about 12 inches higher than the kitchen floor. I did not attempt to proportion the sketch, as I imagine that the readers can comprehend the situation easily as it is.

A is the stop cock shutting off the cold water to the boiler ; it also checks all the hot water to the bathroom and laundry fixtures. B is a stop cock in a pipe terminating over the sink. This pipe is joined to the highest point on the cold water pipe before it (the cold water) enters the boiler. The stop cocks A and B are made to act together by the ferrule fixed over the handles, as shown. In this way, one of the stops cannot be moved without moving the other, making the relative position of the handles always the same, although the effect of the two stops placed in like positions is quite contrary. The relation of the handle to the waterway of B is such that B is off when A is on, and *vice versa*. The object of placing the two stops in this manner is : The cold supply was carried above the top of the boiler in order to keep the boiler full of water in case it becomes necessary to shut off the cold water to boiler. Should the cold water be shut off at A while the stops C and D are off, and the person forget to open the hot faucet G, there would be no relief for the boiler without the passage through B. When the cold water is cut off in the basement, an arrangement similar to that of A and B opens a drain above the stop at the same time the stop is closed. The end of the pipe in which the stop B is placed is furnished with a hose screw, so that when the spring fails a hose can be attached to the cistern pump and the boiler filled in that way. The ends of C and D are continued several feet above the level of the tank overflow and left open to the atmosphere. I found with the stops C and D off that turning off the water over the sink by A would sometimes cause a siphonic action through B, the water coming from the boiler. Opening the faucet H for a moment would always stop the siphonage on account of the delivery pipe being close enough to the bottom opening to reverse the current. The sediment and drain

pipe is located at E and is furnished with the necessary stop, as shown. F is the cold water faucet over the sink. I is a stop cock placed immediately at the boiler, on the bottom connection. At any time if it is thought that the water back connections may be frozen, all that is necessary to prove whether or not they are is to close the stop cock I and open the faucet H. If the connections are frozen at any point the water will fail to flow, as it would be compelled to flow through both of the range connections and the water back in order to get to the faucet H. For general work I would recommend that the cock I be either a valve or key cock ; then the key could be placed out of reach until needed. It is evident that closing a cock in that position at the wrong time might result disastrously. The faucet H can be used in drawing a few buckets of warm water when the pressure is off.

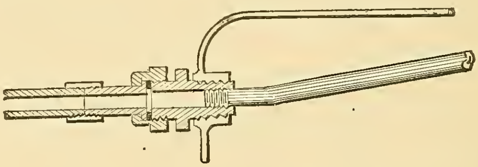


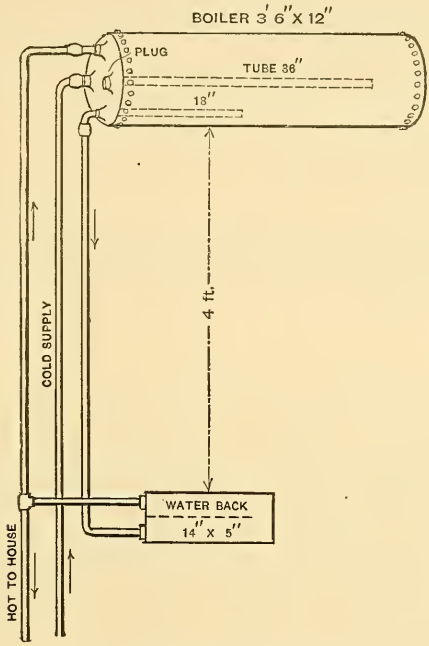
Fig. 2.—Connections to Dome End of Boiler.

The connections to the dome end of the boiler were made according to the sketch, Fig. 2, which is as follows : Upon pieces of pipe the proper length, pitched threads were cut. The threads were pitched as much as possible without preventing the pipe from turning within the boiler, when the pipe was screwed into the inner end of a brass ground joint boiler coupling nipple. When the nipples were screwed up tight on the pieces, marks were made upon the nipples in order to tell when the pipe was in the proper position when screwing the nipple into the boiler. On account of the position of the ends of the hot and cold water pipes in the boiler, as much hot water can be drawn at one time as it would be possible to draw at one time were the boiler in a vertical position.

SHORT CIRCUIT BRINGS COLD WATER.

From H. & J., *Pennsylvania.*—The accompanying illustration is of a water back and range boiler that we have recently inspected that is giving but very little hot water. Two styles of water back and a coil of pipe have been used in fire chamber of range. The boiler is located horizontally over the

range, and it will be seen that the pipe for hot water to the house is also used as a circulating pipe from the water back to the boiler. There is a tube in the bottom connection of the boiler for carrying cool water from boiler to water back. The pipes are all ¾-inch galvanized, and seem to have plenty of elevation where required, but for some reason there seems to be but little circulation. The people who erected this work have put in a number of vertical boilers, which work well, in which they closed up the side or return opening in the



Short Circuit Brings Cold Water.

boiler, and connected same with a T at the top of the boiler where the hot water supply is drawn for the house. Will you kindly give us your opinion in *The Metal Worker*, or refer us to a similar question previously answered.

Answer.—The failure to secure hot water is due to the manner in which the connections are made. Cold water, being heavy, is the first to fall from the boiler. When hot water is drawn from a boiler cold water will enter and fall to the lowest point it can reach. Running the hot water service pipe down always interferes with the flow, and if connected as in this case the hot water will not flow down because heavier and colder water can enter the pipe and pre-

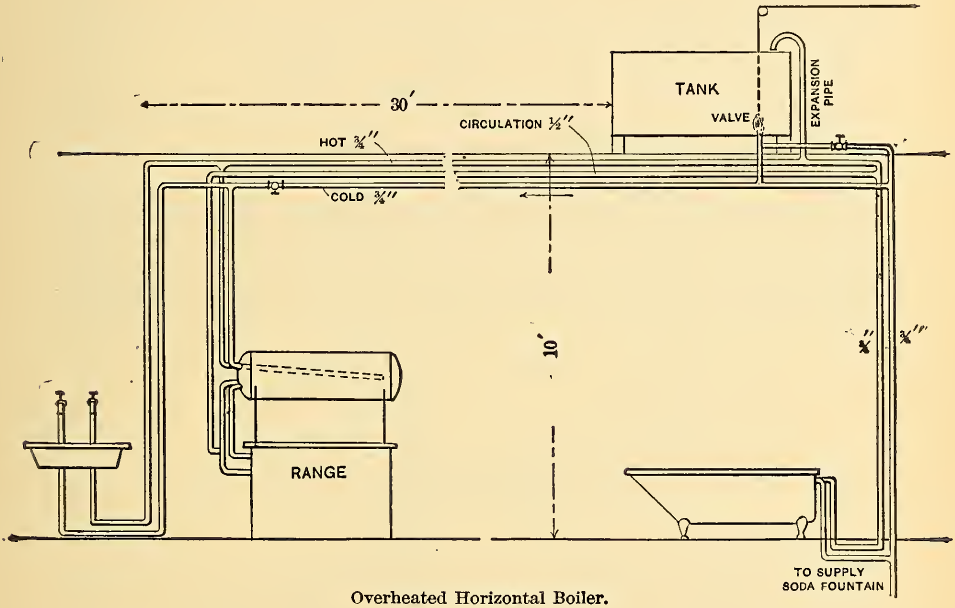
vent it. The movement of water through the piping shown, on the opening of a hot water faucet, would be, cold water would enter the boiler through the long tube and pass out through the short tube below to the water back, and out of it through the usual hot water outlet and into the hot service pipe; the water flowing through the back so quickly that it is not much heated. This would not occur if the return pipe from the water back was connected at the plugged opening in the boiler and the hot water service kept separate. It is probable that no trouble would be experienced with the present connection if the hot water service ran up from the top of the boiler instead of down from the top of the water back. That some hot water can be drawn is probably due to the boiler being full of hot water at the start, but which is soon replaced to the level of the short tube by the cold water that enters. When the return from the water back is connected at the top of a vertical boiler a very different condition exists.

OVERHEATED HORIZONTAL BOILER.

From B. P., *Guilford, Conn.*—I would like to learn from *The Metal Worker* the cause of and remedy for a difficulty I am experiencing with some work which I have done in an apartment house. I have connected a range with a horizontal boiler which holds 18 gallons and which is supplied from a 1000-gallon tank in the next story above. The hight of the kitchen ceiling is 10 feet. There is no city water service and the water supply must be taken trom the tank. At times there is a terrible rumbling at the boiler, which drawing water from the hot water faucet at the sink does not seem to stop. Sometimes at the sink and the bathroom there is almost no flow of water at the hot faucet. The accompanying sketch shows the position of the fixtures and the run of the pipe, which is of galvanized iron. Does the small horizontal boiler with the tank pressure operate as satisfactorily as an upright boiler of 35 gallons capacity? Does the boiler work as well when the water in the tank is quite low as when the tank is nearly full?

Answer.—It is evident that the water back has a larger capacity than is required for the work to be performed. The fact that the boiler lies above the range subjects it to a considerable heat radiated from the top of the range and it also receives from the currents of hot air rising from the top of the range considerable heat in addition to the warmth which is imparted to the water in it by circulating through the water back. Under these conditions with a strong fire it is quite probable that steam would be generated in the boiler, and if the pipe does not have a pitch from the point where it rises from the

boiler to the relief pipe at the tank the steam could not pass off freely enough to prevent the noise reported. The fact that the tank is only a few feet above the boiler would subject the boiler to a very light pressure, and it is possible that under these conditions the steam generated in the boiler would be sufficient to check the flow of water. The difficulty can be overcome by the use of a smaller water back or a larger boiler, or by partially covering the water back with fire brick



Overheated Horizontal Boiler.

or fire clay to reduce its heating power. Where a horizontal boiler is properly connected and is of a size suitable for the work, just as satisfactory results are attained as when a vertical boiler is used. The fact that the horizontal boilers are of small size renders them more readily overheated and makes it easier for steam to be generated in them. The boiler in question would doubtless work better if the supply tank was in the attic of a two or three story house. A greater pressure would act against the accumulation of steam and would effect a better service at the hot water faucets.

PROPER CONNECTION FOR HORIZONTAL BOILER.

From J. G. S., *Newark, N. J.*—I desire to know the proper way to connect a horizontal laundry boiler. The boiler has five holes, two on one end, two on the other end and one at the bottom.

Answer.—For the benefit of those who may be interested in this work we show in Fig. 1 a horizontal boiler which has four openings,

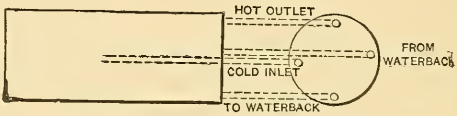


Fig. 1.—All Openings on One End.

all in one end, and have marked the openings for the different pipe connections so that their use may be known. In Fig. 2 we show a boiler of the type described by this correspondent, with two openings in each end as described and one on the under side. Both of

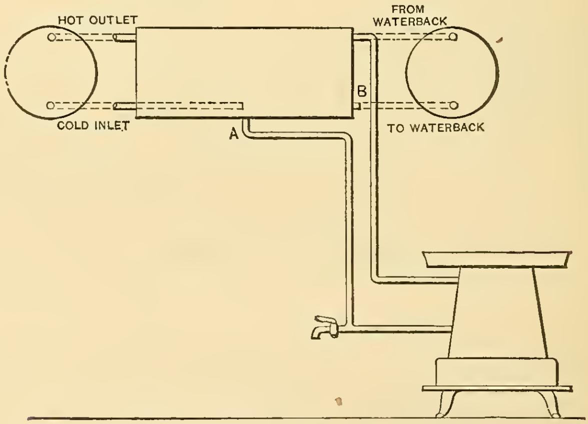


Fig. 2.—Connected to Facilitate Circulation.

the boilers shown are designed primarily for use in connection with a type of range which has become very popular in the past few years, and in the majority of cases the boilers are supported on brackets resting on the top of the range. In the boiler shown in Fig. 1 all the

openings for pipe connections are placed at one end of the boiler, so that the pipes cannot interfere with the supporting brackets. The boiler shown in Fig. 2 has an opening on the under side at A, designed for the use of a sediment cock, so that all mud or deposit that might accumulate in the boiler can be drawn out occasionally. The connections for the water back are made with the two openings in one end of the boiler. A connection like that shown in Fig. 2 cannot readily be made when the boiler is supported on brackets, but with a laundry heater it is far better to plug the opening B and connect the pipe which carries the cold water from the boiler to the water heater at the opening at A. This will afford a better circulation of water and, by attaching the sediment cock as shown, both the water heater and the boiler can be thoroughly cleansed when occasion requires. Some horizontal boilers are made with two holes in the top and two in one end. The holes in the end are for the water back connections and one of the top holes nearest the water back connection is used for the hot water service pipe. The other hole is for the cold water supply and should have a copper delivery tube extending down into the boiler within 2 inches of the bottom. This delivery tube should have a ⅛ inch hole in it near the top to prevent siphoning in case the water supply is shut off.

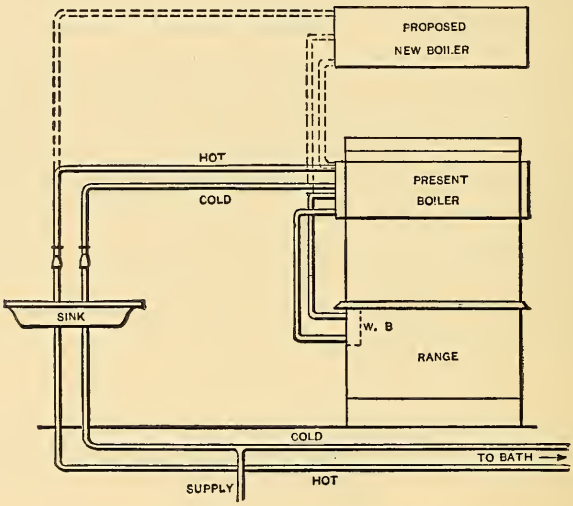
TWO HORIZONTAL BOILERS CONNECTED WITH ONE WATER BACK.

From W. H., *Philadelphia.*—I have a small matter on which I would like to get the idea of *The Metal Worker* and its readers or be referred to some number of the paper in which a similar idea has been ventilated. I have a range with water back and boiler connected to supply a sink and bathroom as shown in the sketch herewith. The boiler now in use fits in apertures in the supporting brackets and a larger one cannot be substituted. My idea is to put another boiler immediately above the present one and connect the two together so as to get a larger supply of hot water. What I would like to know is the best way of connecting the two boilers.

Note.—We shall be glad to present anything our readers may have to say in answer to this appeal to them. In the meantime we would suggest that changes be made in the piping as indicated by the dotted lines. The present hot water service pipe should be disconnected from the lower boiler and connected at the top of the upper boiler. A pipe should be carried from the top opening in the

lower boiler to the bottom opening in the upper boiler, and this pipe should be of the full size of the openings in the boilers.

The pipe bringing the hot water from the water back should be disconnected from the lower boiler and the opening stopped with a plug. This hot water pipe should then be connected with the middle opening of the upper boiler. This method of piping will allow the cold water in the upper boiler to pass to the lower boiler as the hot water enters it from the water back, and the cold water will pass on to the water back and a circulation be kept up. There should be no



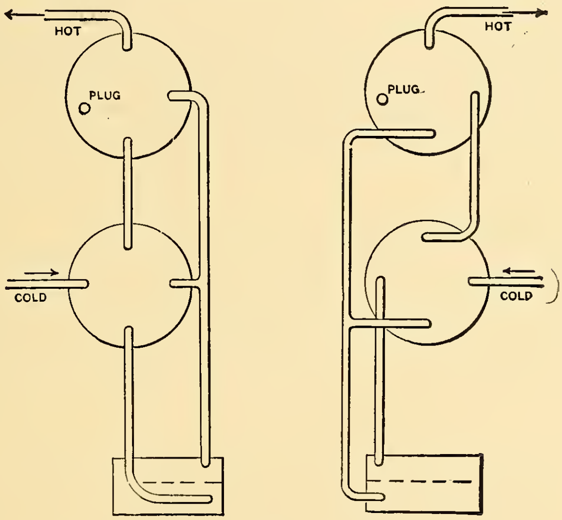
Two Horizontal Boilers Connected with One Water Back.

trouble from the use of two boilers piped in this way, providing the water back has the heating capacity to heat the extra amount of water contained in the upper boiler.

From C., *Philadelphia*, *Pa.*—In reply to the inquiry of "W. H.," in reference to the best way to connect an additional horizontal boiler with one already in use, I submit herewith a sketch showing the twin boiler connections. It will be noticed that the circulating pipes are not connected the same way as recommended to "W. H." I think my plan the better of the two methods, as the hot water from the water back in either case must pass through the lower boiler first and leave it from its highest point. By the plan recommended to "W. H." the return from the upper boiler must enter the lower boiler at the top, or at its hottest point. As all horizontal boilers placed directly over the top of a range

are located within about 16 inches of the top of the range they derive considerable heat from the hot currents of air and from the heat radiated from the top to the outside of the boiler as well as by the heat from the water circulating through the water back. This outside heat will naturally cause the water to be warmed and to rise to the top of the boiler, and in the plan suggested the water in the lower boiler must fall. There are several other points that seem to be an advantage in the system of piping which I present. While the plan of piping recommended to "W. H." may work, the proof of the pudding is in the tasting, and there is no doubt about the plan I suggest, as there are a number of boilers so connected in use and giving satisfactory results.

Note.—The statement that a number of boilers connected on the plan presented by this correspondent are in satisfactory operation is



Two Horizontal Boilers Connected with One Water Back.

a sufficient recommendation, but it has some drawbacks. If hot water from the water back in the system shown at the left enters the lower boiler through the connection for that purpose and there is colder water in the upper boiler seeking to fall to the lower boiler and thence to the water back there is a strong probability of conflicting currents to impede circulation. A boiler located over the range receives considerable heat from the range besides that derived from the water back. Nevertheless when the cold water supply is connected to the lower boiler and water is drawn, the lower boiler will hold the coldest water even though it receives outside heat. When

no water is drawn for some time a direct connection from the water back to the upper boiler will carry the hottest water to it and cause the cooler water in it to fall to the lower boiler if its flow is not impeded by a current of hot water flowing into the upper boiler. The method of piping shown at the right is likely to produce conflicting currents at the point where the two pipes join in carrying cold water to the water back. Of the two methods shown that at the right has some advantages when in full operation, but hot water would not be supplied so quickly on first starting or when a large quantity of hot water was drawn because the hot water from the water back would have to pass through the cool water in both boilers before reaching the hot water service pipe. The method of piping recommended to "W. H." insures a quick supply of hot water and a positive circulation without conflicting currents, even though the lower boiler will receive a great deal of heat from the outside.

CHAPTER IX.

MISCELLANEOUS.

AIR IN DIPPED PIPES.

From L. W. F., *Earlville, N. Y.*—Will *The Metal Worker* inform me in an early issue the proper way to pipe a range boiler? My customer does not want the pipes to appear around the sides of the room, which is nicely finished, yet wants hot water at the sink, across the room from the boiler. Can the piping be taken off the top of the boiler in the usual way and then run down and under the floor, across to the sink and then rise to the faucets? If piped as suggested, will the job give satisfaction?

Answer.—Many boilers are in use piped as described, giving satisfaction, though some annoyance has in some cases been experienced from an accumulation of air in the bend where the pipe turns or dips down at the top of the boiler, if no pipe is run direct to an upper floor. The annoyance, however, has never been sufficient to condemn such a method of piping.

CONNECTED TO OVERCOME TROUBLE.

From C. S., *Bridgewater, Mass.*—Recent discussions in *The Meta Worker* on the subject of range boiler connections remind me of some of my experiences in that line that may be of interest. Some years ago we put in a portable range to take the place of a brick set range that was connected with a 50-gallon boiler. The boiler was set very low, and had been very noisy, and the owner wanted it made all right. As it could not be raised I used the bottom connection for a sediment cock only and connected the lower pipe to the range at the side and the hot water pipe at the top of the boiler, as shown in Fig. 1, and the result was satisfactory.

On another occasion I had a 40-gallon boiler connected in the usual way with an 8 inch portable range that would not heat water enough for a bath after having a hot fire all day. I tried to cure it

by making a connection the same as in the first job, but was not successful. Arranged with a larger water front, it worked all right. I call to mind three other jobs that are connected the same way, one of which I will mention. The kitchen was only 6½ feet high, and as I wanted to use a high stand, and as the pipe had to cross the ceiling I had a boiler specially made without the side connection and

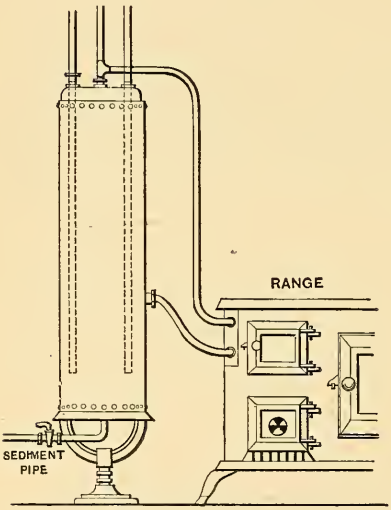


Fig. 1.—Side and Top Connections.

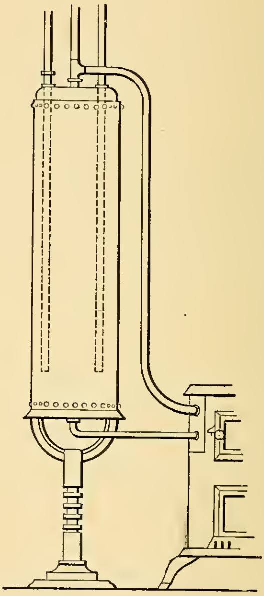


Fig. 2.—Bottom and Top Connections.

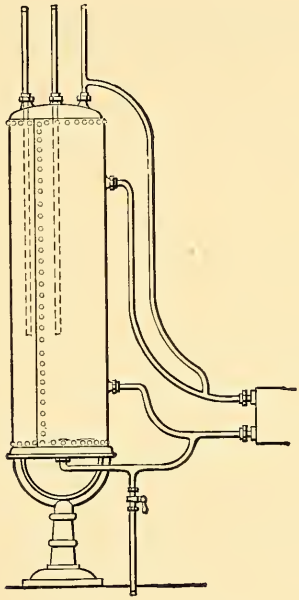
only 4 feet high. The hot water connection on top of the boiler was 1 inch, and was connected to the range with a 1-inch pipe, as shown in Fig. 2. This heats water quickly; but if a bath or two are wanted before it all gets hot it seems to draw the colder water at the bottom of the boiler through the water front instead of taking the hottest water from the top of the boiler.

A CURIOUS CONNECTION.

From W. B. K., *Boston, Mass.*—In recent issues of *The Metal Worker* you have given sketches of different ways of setting range boilers. Four years ago I was sent to a town in New Hampshire to add a few more fixtures to the work

that was in the house. It was here that I saw a boiler setting, of which I send a sketch. It was a fine piece of work, ⅞-inch brass tubing, union bends on boiler and range, the pipes all bent to fit, and no **T**s. It was the nicest piece of work I have ever seen. Will you please tell me what advantage this way has over the usual way of setting boilers, or if it was done for looks only ?

Note.—The accompanying engraving was made from our correspondent's sketch, and shows the double system of connecting the



A Curious Connection.

water back and boiler. We fail to see, however, what particular advantage is to be gained by doubling the pipes in the way shown. The natural circulation will be through the lowest and highest pipes—that is, the water from the bottom of the boiler will enter the bottom pipe to the range water back, and returning, will rise through the top pipe above the boiler. If each of the two pipes from the water back to the points where the double pipes begin was of a capacity equivalent to the combined capacity of the two pipes, then there would be circulation through all four pipes. But we assume, and in fact our correspondent says, that ⅞-inch pipe is used

throughout. We cannot see, therefore, what good purpose the doubling of the pipes will secure.

BOILER HEATED BY STEAM.

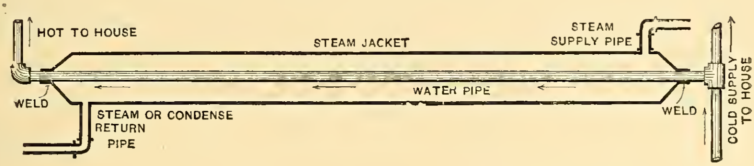
From D. W. B., *Massachusetts.*—A customer of mine has a 60-gallon copper boiler attached to his kitchen range in the most approved manner, but somehow or other he cannot obtain hot water in bathroom until about noon. The range has a large water back and the connecting pipes are 1 inch in diameter. At first I thought the trouble was in the water back, and so put in a new one, but with no better results. I thought that a coil of pipe could be inserted by some means into the boiler, and steam employed to heat the boiler. Steam could be taken from the mill the year around. Do you think that a coil could be inserted in the boiler, or would it be necessary to have another or entirely separate heating arrangement? The water that supplies the boiler is taken from a tank in the attic.

Note.—The way our correspondent has put the question makes it difficult to furnish an answer. He tells us that all the connections are perfect, and the pipes are run in the right way, by which we assume that the connecting pipes in the boiler are led to the proper openings in the water back, and that the two pipes have the proper inclination so as not to interfere with circulation, also that the water back is of sufficient size and well exposed to the fire. Assuming that the work is done as described, in the best possible manner, there is no way to account for the difficulty unless it be that the size of the boiler is too large for the heating surface of the water back. The remedy for that is to put in a smaller boiler or put in a larger water back.

Boilers are made with steam coils in them for heating water and do good service. The only difficulty, in this case, would be in putting the coil in the range boiler. To do this it would be necessary to take the boiler apart and put it together again. The coil could be made to encircle the cold water pipe running down to the bottom of the boiler, the steam being taken into the top and condensed water carried back to the mill through the lower opening. With such an arrangement we do not think there will be any difficulty in getting all the hot water needed.

From J. G.—I would advise "D. W. B." to take a piece of 1½-inch steam pipe, also a piece of 3-inch steam pipe, weld one out-

side the other, leaving a steam space between the pipes. Tap at opposite ends ¾ inch for live steam and drip, and with this appliance he can have all the hot water he wants without using the boiler in his house. The water heats as it passes through the length of the pipe, the amount depending upon the steam pressure. The



Boiler Heated by Steam.

appliance can be used simply as a water back connected to the boiler if he so desires. The sketch that is sent herewith explains the construction more fully.

BOILER WITH STEAM COIL.

From J. B. R., *Atlanta, Ga.*—The building I am in is heated by steam, and I want to have a supply of hot water for my work. I can get the steam and water readily enough, but am undecided about heating it. I am recommended to use an ordinary kitchen boiler with a steam coil in it to heat the water. I know that an upright boiler is preferable where a water back is used, but a horizontal boiler could be used to better advantage, so far as space is concerned, if it is just as satisfactory in operation. I send you a sketch of the two boilers recommended, and would like your opinion as to which is the better. Fig. 1 shows the upright boiler with a spiral coil, and Fig. 2 shows the horizontal boiler with a return bend coil in it. The upright boiler has the usual openings for a water back connection, which can be used at the time of year when steam is not employed for heating, and the openings can be plugged when the water back is not used. I am told that the horizontal boiler can also be furnished with these openings.

Answer.—There is no difficulty in heating water by steam passing through such a coil as is used in either of the boilers shown, providing that the boiler and coil are set so that the water of condensation can run off. The hot water at the top of an upright boiler would not be so quickly subjected to the cooling influence of cold water that would enter the boiler to take the place of hot water drawn off as it would in the horizontal boiler. Aside from these there is little choice between the two styles. The same would be

true when connected with a water back, except that there would be a slight difference in favor of the circulation in the upright boiler.

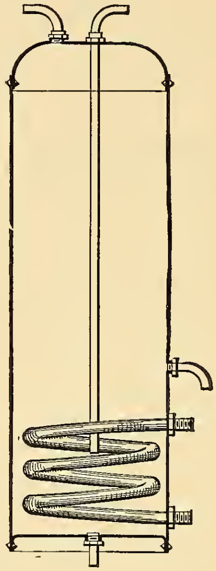


Fig. 1.—Upright Boiler with Spiral Coil.

Horizontal boilers with a steam coil can be furnished with openings for water back connections. If the horizontal boiler is most convenient, there is no reason against its selection. The pressure of

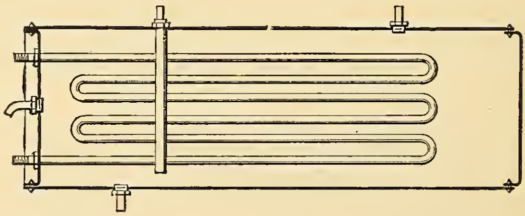
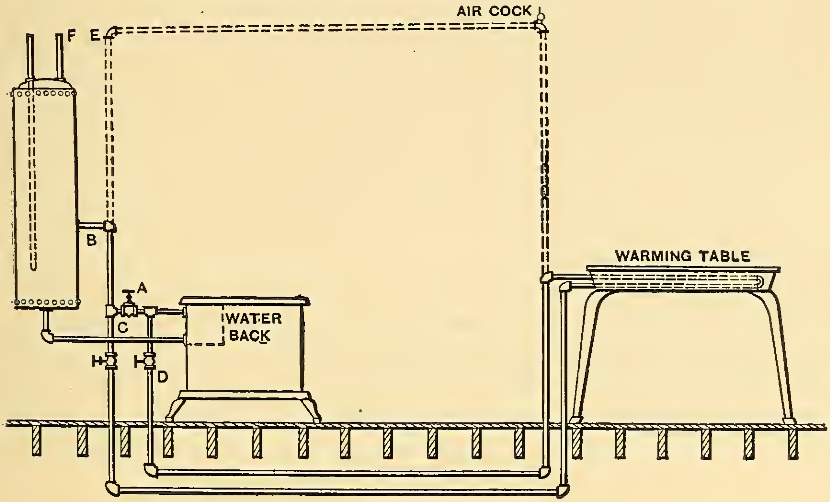


Fig. 2.—Horizontal Boiler with Return Bend Coil.

steam and the size of the boiler regulate the length of the coil. Ordinarily, however, 1 lineal foot of 1-inch pipe is used for every 5 gallons of water to be heated.

RANGE BOILER AND WARMING TABLE.

From G. F. W., *Windsor, Conn.*—Please inform me in *The Metal Worker* if I will be able to get a circulation of hot water through the loop in the warming table without the aid of the stop at A in the illustration. I want to put in the warming table so I can shut it off from the range boiler when not in use and still use the range. Will the system work as I have it arranged, and will it give heat enough to keep dishes and food warm? The loop lies in a copper pan to



Range Boiler and Warming Table.

be filled with water if necessary, and the table has covers to prevent loss of heat. The warming table is 5½ feet long and 2 feet wide and sets 15 feet from a 40-gallon boiler, with which it is connected by ¾-inch iron pipe.

Answer.—In the system shown, under heavy firing steam would form in the water back when the boiler was shut off, and the circulation that could be secured would not produce satisfactory results. To obtain proper circulation we would suggest piping it in the following manner: Use a T at the side connection of the boiler, with a stop cock between the T and and the boiler at B. Run the pipe from the top of the T up to the ceiling and across to the warming table, as shown by the dotted lines, putting in an air cock, and then drop down and connect with the loop. Bring the return from the loop down and under the floor, as shown, and up and con-

nect with the lower pipe from the water back at C, with a stop cock just below the connection, and take out the stop cock at A and all of the piping with the stop cock D on it between the warming table and where it connects with the water back pipe. This system of piping will permit a free circulation, and if any steam is made it can leave the water back. When hot water is to be used to heat the warming table the stop cock at C should always be opened first, then by closing the stop cock at B the hot water from the water back cannot enter the boiler, but must circulate through the coil. This system of piping will shut off the boiler, which may be objectionable, and if the water back has the capacity to heat water for both the boiler and warming table a connection from F to E will make the stop cock at B and the piping from the T at B up to E unnecessary. With this method of piping circulation through the table can always be cut off when desired by closing the stop cock at C. The amount of heat secured at the warming table will depend on the amount of surface exposed in the coil. If the coil is in water it should have 1 square foot of surface for every 3 or 4 gallons of water, according to the temperature of the water in the coil and the amount of heat wanted at the warming table, and as it is improbable that the copper pan will hold more than half as much water as the boiler there should be no difficulty in securing satisfactory results if the coil is properly proportioned to the work.

COST OF HEATING WATER.

From I. G. E.—I wish to present a statement and question, which latter please answer through the Letter Box if the matter is of sufficient general interest. A house has two tenements, alike, except one is ground floor and the other on the story above. A occupies the lower and B the upper. In A's kitchen there is a 30-gallon water boiler belonging to the landlord connected with his (A's) cooking range. The hot water service pipe discharges, first, into A's kitchen sink, second in that of B's above, and these two are the only outlets, and the consumption of water is the same in each family. Now, what proportion of A's fuel is required to warm the water, none being apparently used for this specific purpose? An answer to this will determine B's proportion of the expense, which is the question at issue. If B's consumption of fuel heating no water be represented by 10, what figure will represent A's consumption of fuel?

Answer.—There are two ways to reply to this interrogation. One would be to build a house and furnish it as described, and then make the most careful experiments through the period of an entire

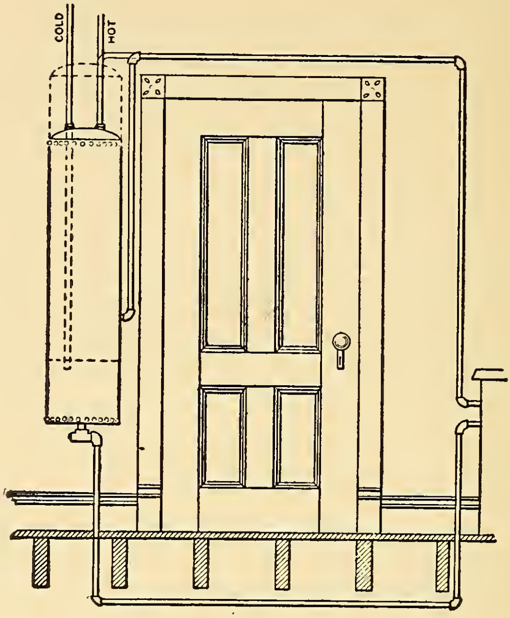
winter, and thus determine the amount of extra fuel required to heat the water in the range boiler. This scheme, however, is a little impractical, so we are forced to the other alternative, which is to figure out the problem on a theoretical basis. We will assume that the consumption of each family is 50 gallons of water per day, so that the total amount of hot water used is 100 gallons, the weight of which would be 832 pounds. As is well known, a heat unit is the amount of heat required to raise 1 pound of water 1° F.; therefore, assuming that the initial temperature of the water is 60° and the final temperature in the boiler is 180°, it will require 120 heat units to each pound of water. Multiplying this by 832 we get 99,840 heat units required to heat 100 gallons of water each day. The heat of combustion of 1 pound of coal—that is, the amount of heat it will give off when burned under theoretically perfect conditions—is about 15,000 heat units. Dividing 99,840 by 15,000 will give about 6½, which will be the pounds of coal required to heat 100 gallons of water from 60° to 180° F. Assuming now that A and B both burn the least possible amount of coal in their respective stoves, A would, under the conditions described, have to burn 6½ pounds of coal per day more than his upstairs neighbor, B. With coal at $5 a ton, or ¼ cent a pound, the extra expense to which A would be put for supplying his neighbor with warm water would be 1½ cents per day, very nearly.

A DOOR BETWEEN STOVE AND BOILER.

From T. M. T., *Norwood, N. Y.*—We inclose you a plan for piping a range boiler where there is a door between the range and the boiler, and would like to know if our arrangement of the piping will secure good circulation.

Answer.—If piped as shown there might be some trouble in the circulation, as it is probable that air would collect in the pipe which runs from the top of the door down to the boiler. If it is possible to raise the boiler high enough so that after the pipe crosses the top of the door it may be connected into one side of a **T**, which is connected by means of a short nipple with the hot water outlet at the top of the boiler, and a hot water service pipe run out of the top

opening of the T, there could be no trouble with an accumulation of air and the water would circulate satisfactorily. It would be



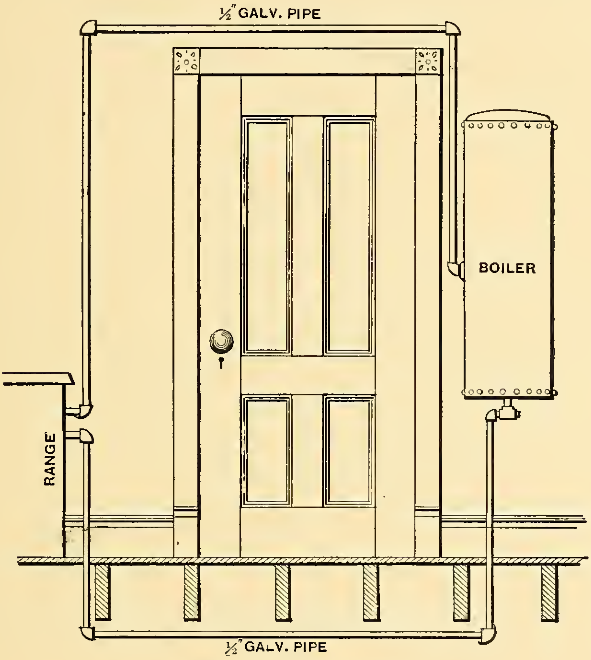
A Door Between Stove and Boiler.

better in a case of this kind to use the largest possible pipe connecting the range and boiler.

SMALL AIR BOUND PIPES.

From E. J. S., *Ramapo, N. Y.*—I have experienced the rumbling noise which has been described as having preceded the collapse of copper range boilers and I will lay my case before your readers with an illustration of it, and hope to learn a method of remedying it by altering the piping system. My tank is 10 feet higher than the boiler, but the rumbling noise is at times very disagreeable and can be heard all over the house, sounding like the noise produced by turning steam under heavy pressure in a vessel of water, as is done in manufacturing establishments for heating water. I have observed that with a very hot fire in the range the noise in the boiler is louder and continues longer than at other times. It generally occurs when water is being drawn from a faucet somewhere in the house, and it makes no difference whether hot or cold water is being drawn. Sometimes, however, it will occur when the fire

is quite low and no water is being drawn. The noise almost always is produced by feeding water into the heater in the cellar, which is connected to the same pipe that supplies the boiler. The boiler is of 40 gallons capacity, stands about 5 feet from the range, and the pipe which supplies it drops from tank on second floor to the cellar, and from thence rises up through the floor to the top of the boiler and extends down to near the bottom. The pipe from the boiler to the water back drops down to the floor and across to the range, where it rises up through the floor and connects to the lower connection of the water back. The pipe from the water back returning the hot water to the boiler rises from



Small Air Bound Pipes.

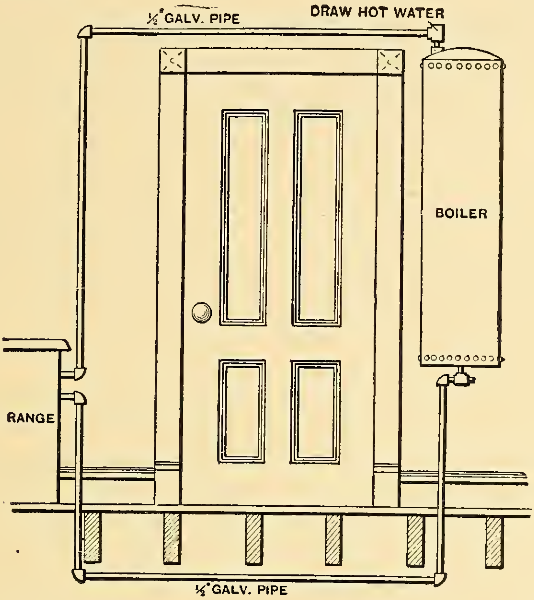
the water back up to a hight a few inches above the top of the boiler and then crosses over and drops down to the connection in the side of the boiler. The peculiar method of piping this return to the boiler was necessitated by having to run it high enough so that a closet door would swing under it. All the pipe is ½ inch galvanized iron, measuring about ⅜ inch inside. The illustration shows the arrangement with the exception of the cold water supply pipe and hot water service pipe.

Note.—We would suggest that the use of larger pipe would give a freer and smoother circulation. The small pipe does not allow the water to circulate with sufficient rapidity to prevent it

becoming overheated in the water back; consequently steam is generated and causes the noise mentioned. The pipe running over the closet door, dropping down to the boiler, is another cause for the noise. If steam is condensed in the pipe it would naturally jar all the pipe in the system, and the rush of water in filling the vacuum produced would also make a shock and noise. We would suggest as a remedy that the boiler be raised up, if the hight of the ceiling will allow, so that the pipe will run directly into the side opening without any dropping down. If this is not possible, the side opening could be plugged and an opening made in the boiler higher up, or if this is impracticable the return pipe from the water back can be connected with the hot water service pipe at the top of the boiler. The rise in the pipe as it passes across the top of the door having no vent permits the collection of air, which would impede the circulation. The slight pressure in the system, from the tank being so little above the boiler, facilitates the generation of steam, and when water is drawn at any of the faucets in the house the pressure is further reduced, which for the time being aids the generation of steam and increases the noise. Where the pressure is slight it is always well to have larger pipes to and from the water back, even to 1 inch in capacity, to provide for a free circulation, so that no water will remain in the water back for a sufficient time to be heated to the boiling point. The ell at the water back must necessarily be a reducing ell from 1 to ½ inch, and by changing both of the pipes leading from the water back to the boiler to 1 inch in size in all probability the trouble reported will be very much relieved, but to be remedied the pipes must be arranged so that air cannot collect in them. It would be better if the cold water pipe was carried direct to the boiler without dropping to the cellar, for as now arranged air can collect in this pipe at the top of the boiler. When pipes are trapped so as to hold air, the air will act as an elastic cushion or spring whenever the pressure on it is reduced by opening a faucet. This action will be more readily produced when there are two air traps as in this system.

From R. E. D., *New York.*—Referring to the letter of "E. J. S.," I take the liberty of inclosing a tracing showing the ordinary manner of connecting such jobs. The outlet used for drawing hot water of course relieves the pipe of air from time to time as water is

drawn. I believe boilers were connected in this manner long before the "side coupling," as it is called, was used on the boiler. It is not always that a closet door is between the range and boiler, but it frequently happens that a window prevents the carrying of hot water



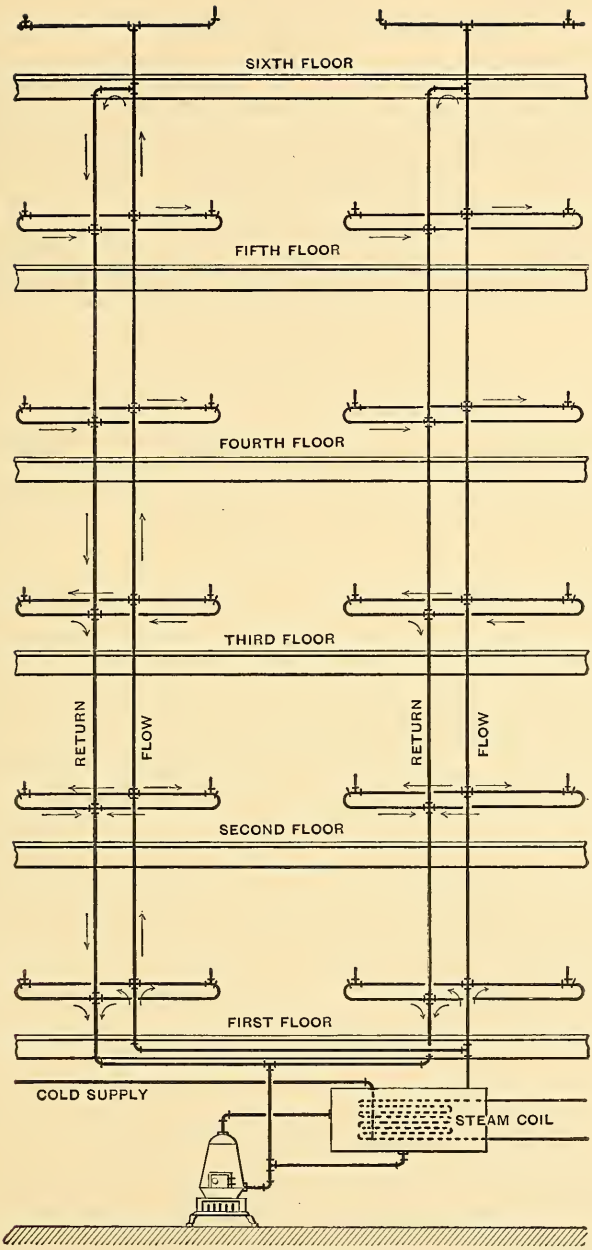
Small Air Bound Pipes.

circulation to the boiler, so that this plan of getting over the top is adopted. As you say, the "pipe is too small," and possibly the water back may not be of the right sort.

From HELIOS.—Referring to the letter of "E. J. S.," will say that if he will take a ½-inch pipe connection from the horizontal pipe over the door and run it up and over the tank on the second floor, leaving the end open, all the air can pass out when the boiler is filled with water. If the water in the boiler at any time should reach the boiling point, all the steam will escape from the pipe over the tank. This connection will stop all the rumbling noise and allow a free circulation of the water. Would advise taking out all the ½-inch pipe and make it ¾-inch inside diameter with a ½-inch air pipe over tank.

SUPPLYING HOT WATER IN LARGE BUILDINGS.

A considerable demand has been created in the last few years for hot water tanks of large capacity for supplying hot water in hotels, apartment houses and other buildings in which hot water is furnished to those who rent a suite of apartments. These tanks vary in size from 100 to 500 gallons capacity. They are so constructed that they may be heated either from steam boilers used in heating the building in the winter time or in summer from a small water heater, with which they are connected in the same manner that a range boiler is connected with a water back, so that either may be used as the circumstances require. In the accompanying illustration we show how the piping is sometimes arranged. These tanks are made in two styles, so that they may be used either horizontal or vertical, as conditions require. In the majority of instances the preference is for the horizontal tank, inasmuch as it may be suspended from the floor timbers or supported on piers, leaving the floor space available for other purposes. These tanks are provided with a steam coil or copper pipe, which is proportioned to suit the pressure of steam which will be used for heating. Where low pressure steam is used, not exceeding 10 pounds pressure, one lineal foot of pipe coil is used for each five gallons capacity in the tank. Where the steam pressure is higher it naturally has a greater heating capacity, and the same amount of coil is expected to heat six or seven gallons of water to the temperature desired for domestic purposes. This virtually is equivalent to 1 square foot of heating surface heating 15 to 20 gallons of water. It is estimated by the manufacturers of the small cast iron water heaters used for house heating purposes that their heaters will heat from one-half to two-thirds as many gallons of water as they will carry feet of direct radiation, the larger heaters showing the greater efficiency, so that a boiler which is rated to carry 300 feet of surface is calculated to heat from 170 to 200 gallons of water. The piping arrangement between the water heater and the tank is very similar to that shown in the picture. The tank is made with an inlet and outlet for connection with the water heater, and with inlet for steam and outlet for condensation for connecting with the steam apparatus. The cold water supply is connected at the top of the tank and carried to the bottom by means of a tube inside. Besides this cold water inlet there is a hot water outlet, and



Supplying Hot Water in Large Buildings.

in proportion to the size of the tank this opening is increased in size. Ordinarily, the service pipe is run full size to the highest floor in the building, branches being taken off to the different fixtures on the different floors, as shown, and sometimes a circulation or return pipe is provided to bring the water which is cooled back to the tank and to furnish a prompt supply of hot water to the faucets. When a return or circulating pipe is provided it is made one or two sizes smaller than the service pipe, as are all branches which are connected with it.

MILKY WATER FROM BOILER.

From H. D. T., *Scranton, Pa.*—Will some of the readers of *The Metal Worker* explain why the water which comes from a boiler which has been in use about six years is milky looking when it is heated?

From A. J., *Wilkes-Barre, Pa.*—I presume that when the water mentioned by "H. D. T." has remained in a vessel for a few minutes it becomes clear and transparent. If my supposition is correct the milky appearance is due to the water being full of small globules of steam. This condition is seldom found except with heavy firing or with a large water back when but little water has been used for a time. This enables all the water in the boiler to be at very nearly an even temperature. The boiler being subject to a pressure from the city mains, sometimes as much as 80 pounds, enables the water to be heated to several degrees above the boiling point, and immediately on opening the faucet this pressure is very materially reduced, enabling the water in the boiler and piping to expand into steam. It runs in this condition with the milky appearance mentioned, and as all of the steam cannot escape instantly some will be carried to the vessel and as it gradually passes off the water will become clear. If the water is what is known as hard and more or less impregnated with lime in solution the excessive heating will liberate the lime, which, if in sufficient quantity, will give the effect described, but which will disappear as the lime settles. I have had tin vessels brought to me to be mended that had quite a scale of lime coating on the bottom, which comes from boiling hard water in them.

CHAPTER X.

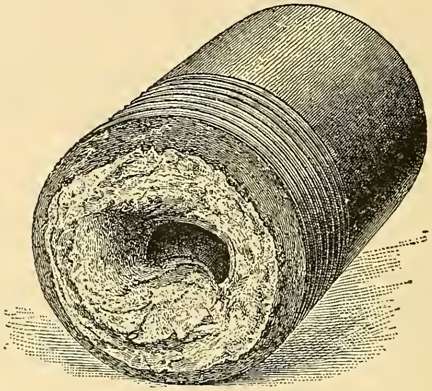
LIME DEPOSIT IN WATER BACKS AND BOILERS.

The deposits from water may be troublesome in many places, and most people are at a loss to understand how they occur. All cold water absorbs carbonic acid gas from air, of which the atmosphere always contains a small percentage. When water thus charged with carbonic acid runs over lime or magnesia, or filters through earths containing these materials, it dissolves portions of them. When heated, the carbonic acid is driven off from the water; and as it is only by virtue of the presence of this acid that water can dissolve carbonates of lime or magnesia, these then resume the solid state, and, adhering to metallic surfaces, form a scale almost precisely as tartar forms upon neglected teeth. It follows that if water fed to boilers and water backs can by chemical means have the carbonic acid expelled and time for the precipitation of earthy matters be allowed, the water will not thereafter form a mineral scale. This is not usually practicable for the water fed to kitchen boilers or water backs. In places where only a hard water supply is available it is better to use such forms of boilers and water backs as will admit of access to their interiors for cleaning. Some waters contain vegetable matter which forms a scale, or which, at least, mingles with the mineral scale. The latter is normally white or nearly so. If it be mixed with matter of vegetable origin it may have a dark color, often resembling chocolate.

AN EFFECT OF LIME WATER.

Through the courtesy of one of our readers in Buffalo we have been furnished a sample of 1-inch iron pipe from which the accompanying illustration has been made. With this piece of pipe a letter came explaining that it was taken from a restaurant kitchen

and was used on the boiler connection. The plumber was called, owing to a trouble with the circulation, to find out the cause and to apply the remedy. It will be seen that the bore of the pipe is



An Effect of Lime Water.

nearly closed by an incrustation due to a deposit of lime, and that the waterway through it was reduced to an area not much larger than a ⅛-inch pipe.

LIME CHOKED WATER BACKS.

From E. J. Y., *Regina, N. W. T.*—Will some reader of *The Metal Worker* inform me of a way to get over my difficulty with hot water connections on kitchen ranges in this locality? We have three ranges connected with upright boilers in the usual way, only in place of water backs we have 6 or 8 feet of 1-inch pipe in a coil over the fire. These pipes block up with a solid coating of a flint like substance in from two to six months, and then burst open. One customer has decided that the expense of renewing is too great, coming as it does every couple of months, and has had the coil taken out permanently. The other customers have theirs taken out regularly every two to six months. The pipes do good service when clean, heating the water quickly when used. The water used is taken from deep wells on the premises and has some alkali in it.

From E. S. M , *Westminster, Md.*—In answer to "E. J. Y.," he may be interested in knowing that I have had the same trouble

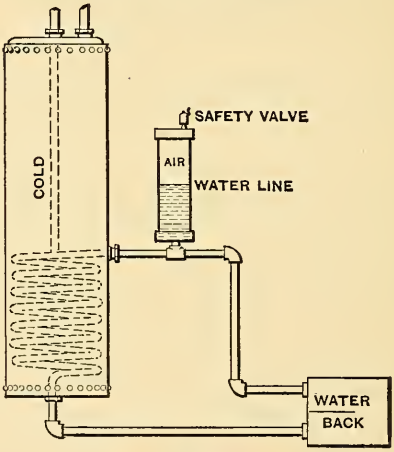
myself, and tried brass piping, thinking it might possibly help the matter, but it did no good. I then put the pipe where the hottest part of the fire would not strike it and have had no trouble with it since, which is over two years ago. It formerly filled up every month. The reason, I think, of the present relief is that the water got too hot and steamed, which it will not do if put where the coil will not be subjected to so high a heat. I know that the stoppage must have come from the water steaming, for the boiler would steam, and I think if "E. J. Y." examines his closely he will find that it also steams.

From Swiped Joint.—A number of correspondents of *The Metal Worker* besides "E. J. Y." find difficulty with choked water backs, which is a common trouble wherever hard water is used. A remedy for this might possibly be found in arranging the circulating pipes connecting the range boiler and water back so that the same water would constantly flow through the back. Suppose the hot water pipe to boiler from back connected to top of boiler, then ran directly downward through center of boiler and out at bottom and thence to the range. This water would lose its heat while passing through the vertical pipe in boiler surrounded and in contact with colder water. The circulation would be constant and would convey the heat imparted to it in the back and lose it while passing through the boiler, thereby heating the water stored in the boiler doubtless quite as well as though it mingled with it. There being no introduction of new or fresh water laden with earthy matter, no deposit would form in the back or pipes to close them. There would necessarily have to be some way provided to keep these pipes full at varying temperatures and permit sufficient water to escape to prevent bursting the pipes when expanded under boiling temperature. It is practical, I believe, and has been done successfully. A young man interested with me in business piped a boiler in some such way a year or more ago and it has given satisfactory results so far. Here there is no need of such an arrangement and hence it is not done. The vertical pipe inside boiler might and perhaps should be larger than the exterior ones—say 1½-inch. I suggest that your correspondents try it.

From W. F., *Hoquiam, Wash*.—I have been looking over some of the replies to the inquiry of "E. J. Y.," Regina, concerning

choked water backs, and I find that the letter from "E. S. M.," Westminster, Md., very nearly hits the mark. I have had quite an experience with water backs on the Pacific Coast, and in some cases they would choke up in no time, but to overcome the difficulty the only thing required is to construct the water back so that the water circulating through it will not get hot enough to boil. In case of any trouble like that mentioned, have either increased the size of the pipe used or decreased the number of pipes in the coil, so that the water in the pipes and boiler would never come to a boiling point. This plan fixed the matter for good every time.

From P., *Paterson, N. J.*—Having noticed the letters of "E. J. Y." and "Swiped Joint," I can say that the latter's suggestion of running a pipe through the boiler is feasible. There should be 1



Choked Water Backs.

square foot of surface exposed in the pipe for every 5 gallons of water in the boiler to insure the water being heated. A pipe running down through the boiler would not be enough. Boilers for heating the water by steam are made with coils of proper proportion in them. With such a boiler it would only be necessary to use a closed expansion tank attached to the pipe from the water back. This tank is simply an air chamber and should not be entirely filled, and should have a safety valve at the top, as shown by the sketch.

If it was made of 3-inch pipe, 18 inches long, and connected to the piping, it would be ample. The pressure under which the circulation would take place would depend upon how much the air was compressed by the expansion of the water when it was heated. The water might be heated in the pressure system several degrees above the boiling point and would heat the water in the boiler faster in proportion to the increased temperature. If rain water or distilled water was used in the pressure system the water back or pipes would never become choked or reduced in capacity, and it is probable that there would not be sufficient deposit in the boiler or the cold supply or hot service to make trouble.

From D. H. B., *Phœnix, Ariz.*—Having read the article on "Choked Water Backs," would say that one of my "steady jobs" here is putting in new water backs. The water here is full of alkali, so much so that water standing in an open vessel, cold, will leave a noticeable deposit; and when heated deposits very rapidly and in large quantities a substance that is almost impervious to liquids of any kind. I had the idea that a large pipe should be used in making coil water backs, but found after a fair trial that ¾-inch pipe is the best size to use, and that only one coil should be used, as it is not so liable to fill up with sediment. I have found that it is an absolute necessity to have the cold water pipe to the water back as straight as it is possible to get it, and when it is, that the water back will last from two to six months longer. The only remedy that I know of to clean a choked water back is to put in a new one. I put in one yesterday to replace one that was burned entirely through, the city pressure (of 40 pounds) being on all the time and no complaints to speak of, except from the cook, who said he could "get no hot water" and that the fire box of the range was "wet" every morning. The two burned ends, being solid with deposits, kept it from leaking.

REMOVING LIME FROM WATER BACK.

From PLUMBER, *Allentown, Pa.*—The water in our town is of such a nature that the water back used with the ordinary kitchen stove will soon be filled with a deposit which destroys its usefulness and makes it necessary to replace the water back. I have accumulated a large number of these water backs and would like to know if there is any way in which the deposit can be removed readily. The water backs are as good as new, with exception of the

deposits, and are for stoves that are used in this vicinity, so that there would be a ready sale for them if they were cleaned out.

Note.—In communications that have appeared in *The Metal Worker* it has been stated that common washing soda placed in a kitchen boiler and left under a mild firing for from one to three days will so soften the lime deposit that the circulation of the water between the water back and the boiler will wash the deposit into the boiler, where, by opening the sediment cock, the soda and dissolved accumulation may be run off. It is a well-known fact that washing soda is frequently used in steam boilers to remove the scale from the surface. With this information before us it seems reasonable that if the water backs in question were immersed in a large vessel filled with a strong solution of soda and water, and the water was kept at a temperature approaching the boiling point for several hours, the deposit would be sufficiently softened to be readily washed out. The experiment is simple, and in case there are a large number of water backs might be worth the trial.

From J. D., *Malvern*, *Pa.*—I notice the letter of "Plumber," and in answer would say that I have had some experience and some trouble with the deposit of lime in the water backs of ranges and find that the best way to get it out is to draw the water all out of the boiler and disconnect the pipes from the water back and then to burn the water back about two days without any water in it. Then take the water back out of the stove and tap it with a hammer and the lime will all come out. I have tried several other plans, but this is the best and gives the least trouble. I have some water backs that fill up every six months and that is the way I get them clean. I give my method and trust it may be of some benefit to the rest of the trade.

From MANUFACTURER, *Ohio*—Having had some experience with water backs that have become choked with lime deposit I contribute the following for the benefit of those who have recently asked in *The Metal Worker* for a remedy. A number of water backs of different manufacturers that were in frequent demand and which were full of deposit were brought to my attention and I got possession of them for the purpose of experimenting. Having had trouble with

scale in our boilers and found that soda had a softening effect, I put these water backs to soak in a solution of soda and water and heated the solution. Where there was still an opening clear through the water back for the solution to enter the deposit shrunk away from the iron and took a chalky form that could be removed without much difficulty. Give the solution sufficient strength and plenty of time to work and water backs that otherwise would be useless can be restored for further service. I had success with this method and see no reason why it will not be satisfactory when used by others.

Heating Rooms from Kitchen Boiler.

CHAPTER XI.

HEATING ROOMS FROM KITCHEN BOILER.

Before attempting to heat a room with hot water from a kitchen boiler, it must be understood that the water back shall have ample capacity to heat the extra amount of water that will be continually required. If the supply of hot water is insufficient for the ordinary domestic uses, any attempt to heat a room in this way will prove unsatisfactory. No reliable information is obtainable as to the heating capacity of a water back, and the personal judgment of the one having the job in charge must be relied upon A water back that lies where the ashes can be readily removed from its surface and where the draft draws the heated gases against it will heat more water than one located under reverse conditions. A fire chamber that is nearly square is likely to heat the water better in a water back than a long, narrow fire chamber. The construction of the water back also has an important influence on its efficiency; those with a partition have a greater water heating power than those without. There being sufficient capacity to heat the water, the connections with the water back and the boiler should be made correctly and carefully.

The radiator is the next fixture to be considered, and in determining the proper size no little skill is required. The rules used by the men who make a specialty of heating houses with hot water, in some cases, are so simple and dependent upon individual judgment in their application that they are of little value. Other rules are so exhaustive in the consideration of the details as to make them cumbersome and of little use to the average man. A common method, for instance, is to use 1 square foot of surface in the radiator for a given number of cubic feet of space in the room to be heated. This varies from 30 to 50 feet, depending upon the location of the room. If it is on the cold side of the house, with three walls exposed, more heating surface will be necessary than if the room were on the warm side of the house and only one wall exposed.

The size of the pipes depends upon the size of the radiator, but as the radiators commonly used in connection with a kitchen boiler seldom contain more than 20 feet of radiating surface, the house water service pipes ordinarily used will answer the purpose; although to secure the benefits resulting from a very rapid circulation they should be increased to ¾ or 1 inch. These pipes must be run with a gradual rise all the way to the radiator, and an air vent must be provided at the top of the radiator to let the air escape, otherwise it will be impossible to get the radiator entirely full of water and the air will interfere with the circulation. As the water in such a heating system is also likely to be drawn off for household use, there will be less liability of its being rusty if lead or galvanized iron pipe is employed. An expansion tank will be unnecessary when the radiator is connected with the boiler, but when the radiator takes the place of the boiler and the system is once filled with water and no continual supply is pressing to enter, some provision must be made for the expansion of the water when heated. In the latter case an expansion tank should be connected, if possible at the highest point, and if desirable may be connected with the radiator, when it will act both as an expansion tank and as an air escape. In some cases an attempt is made to use the radiator on the same floor with the boiler, and the difficulty of getting circulation in such systems often interferes with their satisfactory operation. Some examples of this method, however, are given for the benefit of those who wish to try the experiment.

HEATING POWER OF A WATER SIDE.

From M., C. & S., *Towanda, Pa.*—Will *The Metal Worker* tell us whether or not a 5-foot range with a water side 22 x 10 inches and a fire box 22 x 12 x 10 inches deep will heat a 42-gallon boiler and a coil of 100 feet of 1-inch pipe with open pattern return bends, and an air cock at the highest point, as shown in the sketch?

Answer.—It is not necessary to give the sketch, which shows the coil just above the level of the top of the water back in another room. From Y-branches in the pipes between the water back and the boiler pipes connect with the coil. The hot water or flow pipe runs straight up to a point just below the top of the coil, when it runs to the coil with a gradual pitch. The return pipe has a down-

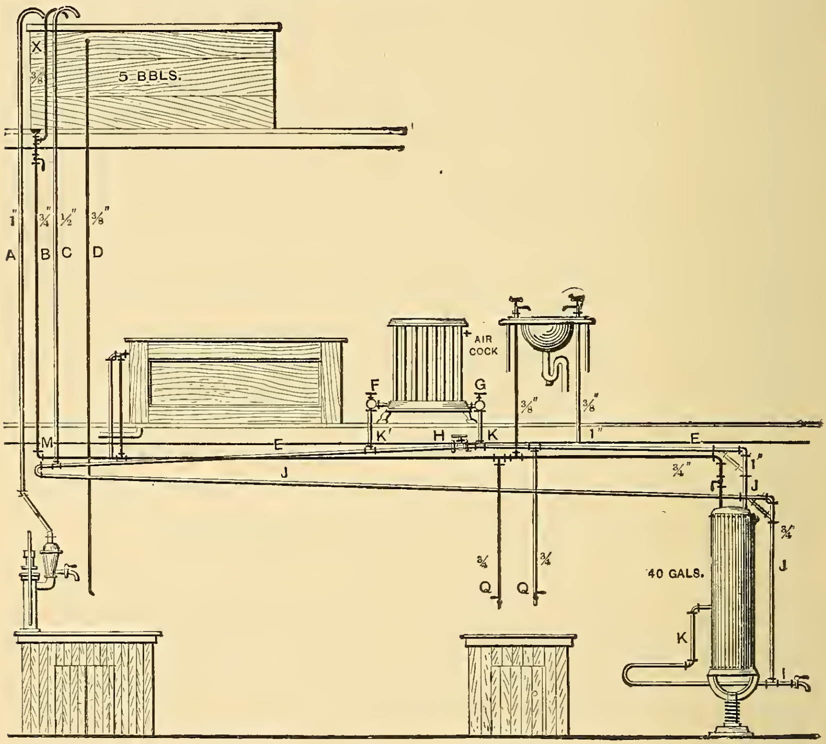
ward pitch from the coil to the branch. The sketch shows a stairway between the coil and the boiler, which necessitates an offset in the pipes to pass it. An angle valve is placed at the inlet of the coil so that its use can be discontinued when not required for heating, and an air cock is placed at the other end of the coil. With this explanation of the conditions they are readily understood. No data exists giving the heating capacity of water sides, or water backs, as they are generally called, but much smaller water backs in smaller fire boxes heat the water satisfactorily in boilers of twice the capacity mentioned. We think no trouble will be experienced from that source. When the room to be heated is on the floor above the range there is little difficulty in securing good circulation, but with the room on the same floor trouble is often experienced. Circulation is best when the radiator is well above the boiler, or, as in this case, the water back. The difficulty in the present instance can be remedied by connecting the flow pipe to the radiator with the hot water service at the top of the boiler or running it up from the branch nearly to the ceiling and then around to the radiator before dropping down and making connection. The air cock must then be changed from the radiator to the highest point in the flow pipe. Such a change will facilitate the circulation and better heating will result.

A PLAN FOR HEATING BATHROOM.

From J. I., *New York.*—I send you herewith plan of a job I have to do, and wish to know if I can heat a bathroom 5 x 12 feet with radiator connected with the range boiler, as shown on the plan. You will notice that E is a 1-inch circulating pipe, being run beyond the radiator as far as the return bend M, the return J from there to boiler being ¾ inch. I propose to open F and G and close H to heat the bathroom, and reverse this to keep the bathroom cool in summer. C is a ½-inch expansion pipe fron the circulating pipe E, D a ⅜-inch telltale pipe, A 1-inch supply pipe from pump to tank and N circulating pipe to water front.

Answer.—To heat the bathroom specified our correspondent will need about 12 square feet of radiator surface. A water back or water front can usually be relied upon to carry about 50 to 60 per cent. more radiator surface than the surface of the boiler adapted to use with it. The exact relation of the heating surface of a front or back to the amount of radiating surface it will carry has not been determined, so far as we are aware. To carry with efficiency an

amount of radiator surface of 50 per cent. more than the surface of the boiler itself the boiler must be covered with felt or some other non-conducting material, as otherwise, much of the heat from the water will be imparted to the air and other objects in the room in which the boiler is placed. The plan, as shown by our correspondent, has been well schemed out as a whole, and will probably work well



A Plan for Heating Bathroom.

if he uses an open return bend at M, and instead of the right angled elbows at the tops of the pipes J and J′ uses 45° elbows and gets easy turns of the current in the pipes at these points. He should endeavor to get an easy upward inclination of the supply pipe from the top of the pipe J′ to the tee marked K, and a corresponding downward pitch from the tee K′ to the return bend at M. The inch supply pipe should be large enough for a radiator of the size named

if unnecessary obstructions are not introduced. Of course, if the amount of surface proposed be used for heating the bathroom the amount of hot water that the boiler can supply for other uses will be materially less than it could furnish were the only means of escape for heat to be the surface of the boiler itself.

PIPING TO RADIATOR.

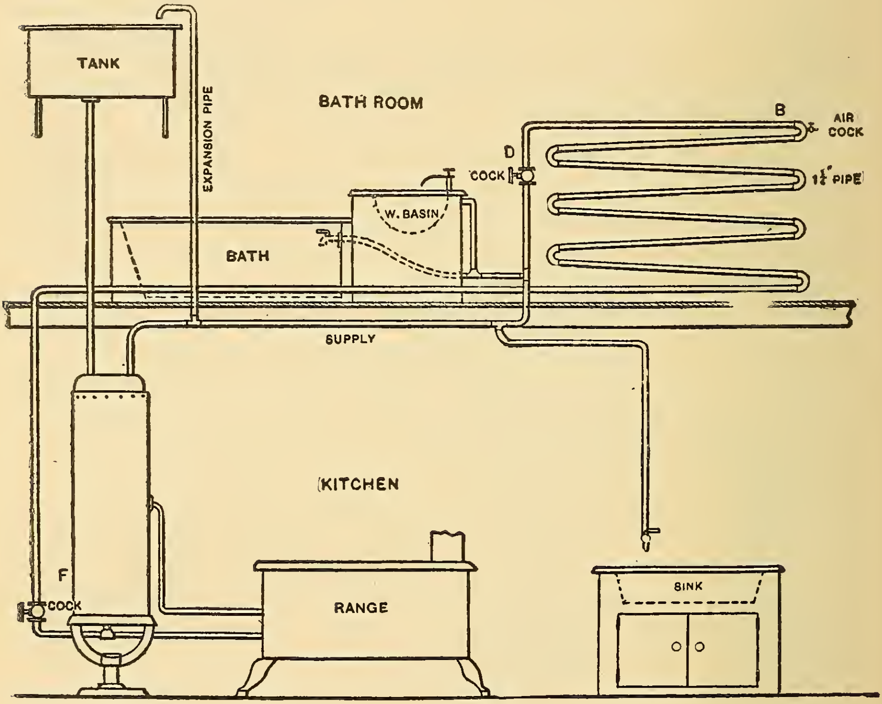
From J. R. F., *Connecticut, and* J. Q. B., *New Jersey,* we receive letters asking respectively for the best method of heating a bathroom from a water front and if a kitchen boiler can be utilized for heating a bathroom by means of connecting pipes between the boiler and a radiator in the bathroom.

Answer.—To consider the last question first, the answer is yes. To answer the first question, there are some simple rules that must be positively observed and will apply to the average case. It is assumed that the water back and stove have ample reserve power to heat the extra amount of water needed. In cases where the bathroom is directly above the stove it will not be a hard room to heat, and 1 square foot of radiating surface to every 40 or 50 cubic feet of space should prove satisfactory. The radiator must have an air cock at the top to let the air out when water is let into it. As a precaution against getting rusty water into the boiler use lead pipe or preferably ¾ or 1 inch galvanized iron pipe, connecting it with the hot water service pipe at the top of the boiler and running direct to the radiator. There must be no decline or horizontal runs in this pipe, but a positive inclination upward maintained all the way. This is to let air pass to the radiator and escape through the cock and to provide for an unobstructed flow of water. Another pipe of the same size must be as carefully returned from the radiator to the boiler and connected with the pipe at the bottom of the boiler that runs to the water back. A stop cock should be placed in both the flow and return pipes of the radiator to prevent circulation through them in summer when the heat is not needed.

A TESTED SYSTEM.

From M. S. M., *Woodstock, Vt.*—Some time ago I saw published in *The Metal Worker* a plan for heating a small room by means of a coil connected with a range boiler. This year I had occasion to

heat a small room in a house, and decided to follow the suggestion that I had seen in *The Metal Worker*. You may be interested in knowing that the plan worked very successfully, and I take pleasure in sending you the following account of it, with a sketch showing the arrangement of pipes. The coil, which is in a bathroom on the upper story, is made of 1¼-inch pipe, and as you will see by the sketch the supply enters on top. The upper length of pipe



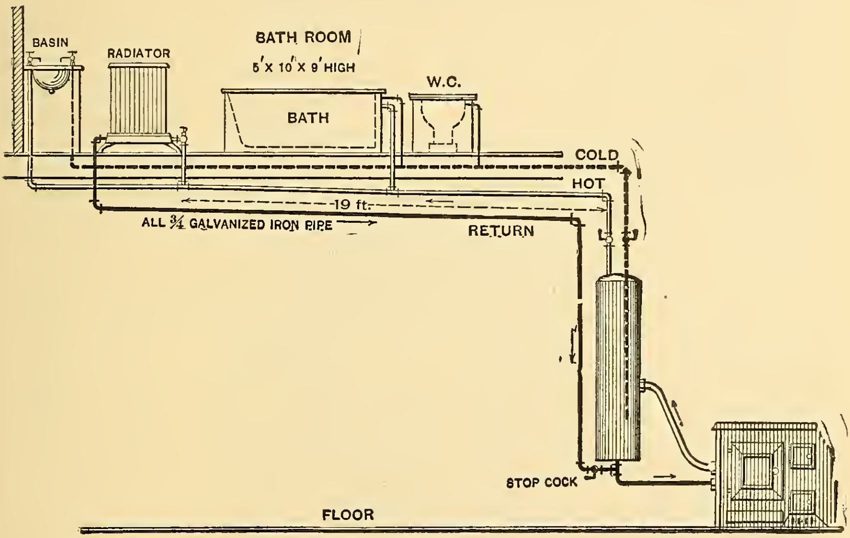
A Tested System.

is level and so is the lower length. From the air cock B the intermediate lengths pitch downward alternately, making altogether four loops, the downward pitch being ¼ inch to the foot. I think that this rapid descent of the pipes gives increased circulation of the water, and will produce better results. The supply to coil is ¾-inch heavy lead pipe and the return is the same. By this system any one can have a bathroom kept warm at no expense whatever for

heating. In making the coil the threads have to be cut crooked where they enter the return bends, and I think anybody who attempts to duplicate this system will find it quite a nice job to make the coil and get it working right. The stop cocks D and F on the flow and return pipes are for shutting off the circulation in the summer.

AIR BOUND RADIATOR.

From R. J. M., *Dover, N. J.*—I am a young plumber and apply to the Letter Box for assistance to get proper heat from the fixtures shown in the illus-



Air Bound Radiator.

tration. The bathroom contains 450 cubic feet of space and has a cast iron radiator with 16 feet of surface connected with a 40-gallon kitchen boiler. The pipes are all ¾-inch galvanized iron except that to the lavatory, which is ½-inch. There is a Detroit valve on the radiator and a stop cock on the return at the bottom of the boiler to stop circulation in summer. When the job was put in operation this fall it failed to heat. One evening I attended the fire from 7.30 until 10 o'clock, and while steam came from both of the lavatory faucets the water in the radiator did not become more than tepid and the boiler in the kitchen did not get hot below the hot water connection from the range. It is a

40-gallon boiler setting not more than 2 feet from the range. I was compelled to use square bends, as the customer wanted a neat job and has all of the piping arranged on a board. I am at a loss to know why the job will not work. The pipe from the radiator ought to act as a circulating pipe and keep the radiator hot, and with a good fire there should be no trouble at the boiler. The pressure of the water supply is ample to fill all the fixtures. When I found the radiator would not heat I shut it off, and since then the customer reports that he can only get the water in the boiler hot enough to scald when he has a roaring fire. Can the difficulty be in the water back? I have done a number of plumbing jobs, but this is the first that has given me any trouble, and I cannot locate the cause, but hope to get some explanation through *The Metal Worker*.

Note.—It is likely that some of our practical readers can help this correspondent. The failure of the radiator to heat is probably because it is air bound, as no mention is made of a pet cock or air valve in the radiator. To put one in the radiator at the top should remove all trouble in heating. If there is a burr on the pipe it would obstruct the flow of water through it to some extent. The failure of the boiler to heat when the radiator is shut off, except when there is an extra fire, points to lack of water back capacity, or some defect either in the water back or the two pipes connecting with it. Provision should be made for an unrestricted flow of water, of the full volume of the pipes, through them and the water back. If the water back used has a partition cast in it this may extend too far, or the mold may have "broken down" and reduced the waterway, or if the wires and rods used to support the core have not been removed they might produce the same result. Under such circumstances the circulation would be of such small volume that a large body of water could not be heated quickly, and under heavy firing steam would readily be produced. If the water back is small and so located in a small fire chamber that ashes accumulate quickly and the draft of the smoke and gases is away from it, a large supply of water could not be heated. The arrangement of the pipes, as shown in the illustration, presents no defects in principle, and the trouble must arise from some fault in the piping.

From F. N. P., *Washington, N. J.*—In answer to the inquiry of "R. J. M.," I would say: Put a stop cock on the pipe from the bottom of the boiler above where the return from the radiator branches into it and he will get circulation through the radiator.

HEATING FROM HORIZONTAL BOILER.

From A. F. E., *Philadelphia.*—I have sold a number of ranges with horizontal circulating boilers, and they all make more hot water than is required for ordinary family use, the water getting so hot that it is necessary to let it run off

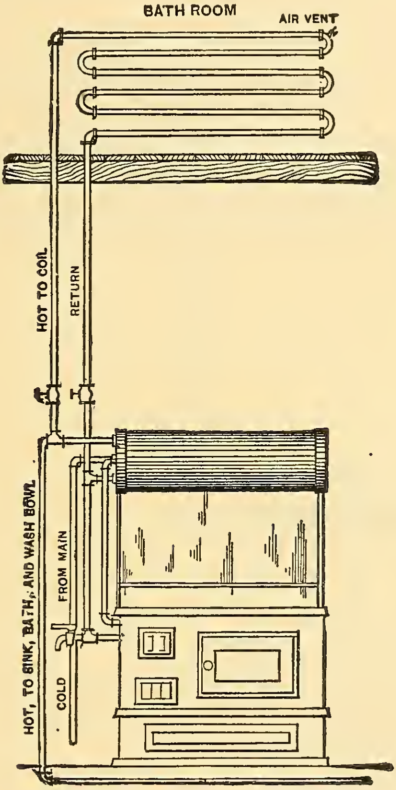


Fig. 1.—First Plan.

from time to time. I have another of these ranges to deliver now in a house where the bathroom cannot be heated from the furnace in the cellar. I therefore thought I could utilize the hot water, which generally runs to waste, in heating this room by means of a coil of pipe supplied from and returning to the boiler and water back of the range. Inclosed you will find a rough sketch, Fig. 1, showing the relative positions of the range, sink, bathtub, &c., also my idea of the proper way of connecting the coil with the boiler—that is, entirely independent from the supply of hot water leading to the other fixtures. The bath-

room is small—about 6 feet 6 inches by 7 feet, with the ceiling 8 feet high. The kitchen is 12 x 14 feet, with 9-foot ceiling. The plumber who is fitting up the bathroom has submitted a plan which I cannot understand (it is shown in the sketch, Fig. 2), and, being almost a novice in this kind of work, I have concluded to refer the matter and the following questions to you, knowing that you are always ready to give assistance when called upon in matters of this kind: 1. Is it practicable to heat a small room from such a supply of hot water? 2.

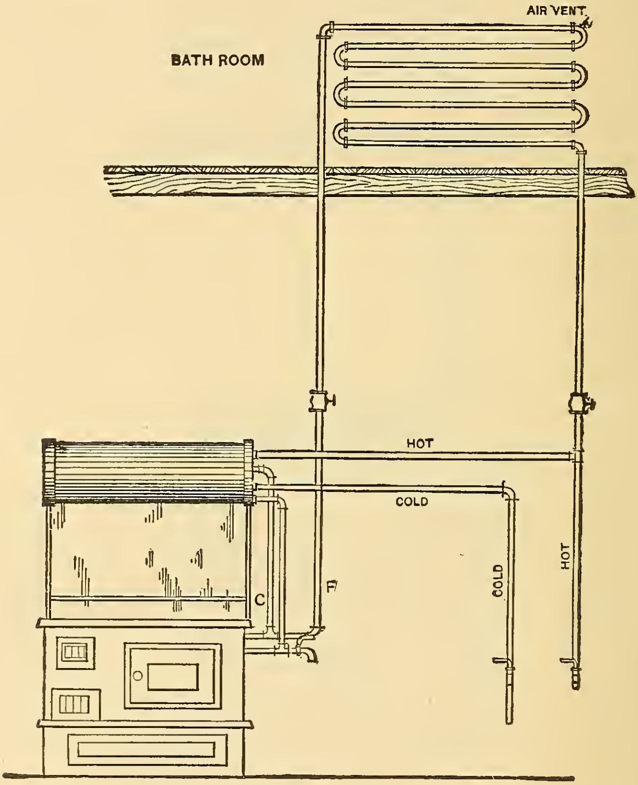


Fig. 2.—Second Plan.

Which of the two plans is nearer correct? 3. What changes are necessary to make it work? 4. Can I use a coil, and of what length and size (plain or galvanized) should the pipe be, or should I use a radiator? I would prefer to use the coil, on account of the limited floor space in the room.

Answer.—Figs. 1 and 2 are copies of the sketches inclosed by our correspondent. In reply to his query, we would say: 1. It is quite

practicable to heat a small room from the water back and boiler of a range, and several instances exist where this source of heat is used with satisfaction. 2. The arrangement of the pipes connecting heating coil with water back and boiler of range is correct, as shown in Fig. 1. Here the circulation between the back and boiler is fully maintained and is direct, while the circulation between the boiler and heating coil or radiator is also secured, the descending or cooler column—that is, the return water from the heating coil—being arranged to flow in the same direction as the same column from the boiler to the back. In Fig. 2 the flow pipe, or ascending column, F, is taken directly from the water back to the heating coil, on the horizontal part of which pipe is a branch called a circulating pipe, C, to boiler. When starting the fire, the circula ion through pipe F to heating coil will be more rapid than through C to boiler. The water in the boiler will become heated by the return water from heating coil, as well as the partial circulation through pipe C. As the temperature of the water in the boiler increases, the circulation through the heating coil will decrease, and if the temperature of the water in the boiler should become equal to the temperature of the water in the coil, which is not improbable, the circulation in the heating coil will cease. If a valve was placed on the circulating pipe C and closed when the coil was used the circulation would be continuous and the water in the boiler would be slowly heated by the return water from the coil. When hot water is drawn off for domestic purposes, if the pipes are arranged as shown in Fig. 2, the temperature of the heating coil will be immediately reduced, as the hot water in the coil is as liable to be taken off as that in the boiler, whereas in Fig. 1 the liability to withdraw the hot water from the coil does not exist, and the incoming cold water only retards the supply of heat to the coil. The difference between the two plans may be thus summarized: In Fig. 1 the heating of the domestic water supply in the boiler is not interfered with, and the circulation through the heating coil is not liable to be reduced or to cease; whereas in Fig. 2 the heating of the water in the boiler is liable to stop the circulation in the heating coil, and the withdrawal of hot water for domestic purposes and the incoming cold water will tend to cause irregular circulation between back and coil, and back and boiler. Replying to our correspondent's third question, no changes are necessary in Fig. 1 plan to make it work. For the radiating surface a return bend coil may be used of 1¼-inch pipe. The length of coil may be about

3 feet 6 inches, eight to ten pipes in hight. The flow and return pipe may be of ¾-inch pipe, if the coil is not unusually far from the boiler. The use of plain or galvanized iron pipe is a matter which may be determined from experience when considering the requirements of the case. So far as heating the air is concerned, plain pipe is more desirable than galvanized pipe, but the latter pipe is presumed to be less liable to produce rust in the water for domestic purposes. There is no objection to the use of a radiator if preferred.

BOILER SET IN BATHROOM TO HEAT IT.

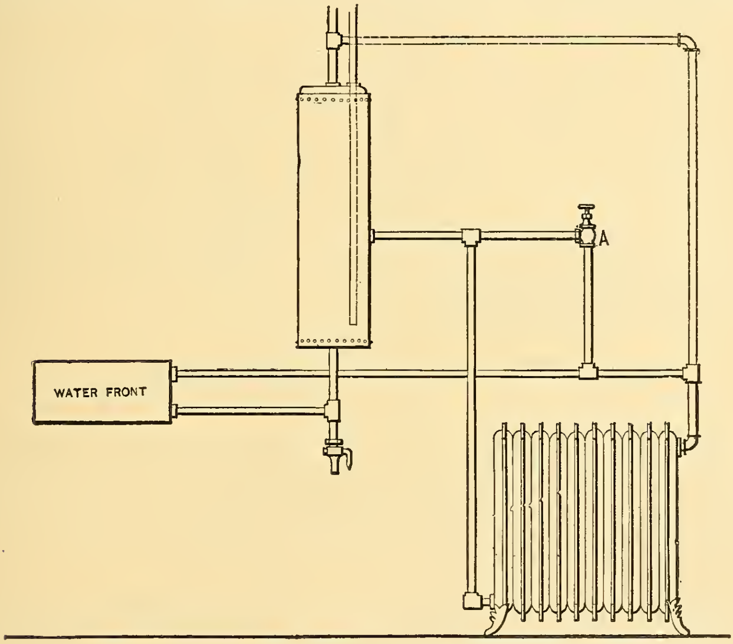
From J. H., *Williamsport, Pa.*—Can you or any of the readers of *The Metal Worker* inform me whether a hot water boiler attached to a range and set upstairs in a bathroom will keep the room at such a temperature as to prevent water from freezing during zero weather? How near must the boiler be to the stove and how far can it be removed from the stove and still circulate? Also, can a boiler stand near the stove and the pipes run up to the bathroom and connect to a radiator? Will this plan keep the room warm, and what size radiator will it take to heat a room 8 x 8 in size or thereabout, the room being on the outside of the house?

Answer.—The quantity of hot water surface necessary to heat a room 8 x 8 feet, situated "on the outside of the house" (by which we infer that our correspondent means having one side exposed to outside temperature) and 10 feet high is 25 square feet, more or less, according to the character of the building, whether very substantially built or not. About 18 to 20 square feet will suffice to keep it warm enough to prevent danger of freezing, and a good sized range boiler would have very nearly or quite this amount of surface. Its use would, however, compel the maintaining of fire night and day in the range. Such a boiler may be made to work well if properly connected with the water back when placed one or two stories above the range. With such a position the pipes connecting the boiler with the water back in the range ought to be 1 inch to insure good circulation. Pipes may also run from the boiler when placed near the range and supply a hot water radiator in the bathroom. The work in either case ought to be done by a skillful man, however, one who can take into consideration all the local conditions and provide for them as they may require. We do not know that any definite limit of distance at which water may be made to circulate through a water back and the boiler of a range has ever been established, if

such a practical limit exists. If sufficiently large pipes are used for connections, it seems from general principles that circulation might be secured at a considerable distance provided a proper inclination of the pipes could be obtained. The radiation from the pipes cooling the water tends to retard the circulation, but the limit of distance to which the water would flow before becoming absolutely cold would not likely be reached in such domestic apparatus.

RADIATOR BELOW WATER FRONT.

From F. P., *East Fairfield, Vt.*—Please inform me, through the columns of *The Metal Worker*, if a radiator may be connected with a water front on a range



Radiator Below Water Front.

where the radiator is on the same floor with the range and where the pipe has to run under the floor from the range to radiator. A boiler is used likewise in connection with the range. The water is taken from a large tank in a room 10 feet above the range and radiator.

Note.—There will be very slow and inefficient circulation through a radiator placed on the same floor as a range, and connected to

the water front of the range, with the pipes passing under the floor from range to radiator. There will be difficulty under such conditions in making a satisfactory working arrangement, and we do not think it worth the trouble for our correspondent to try to do it, assuming that we have correctly inferred the surrounding conditions from the meager explanation given.

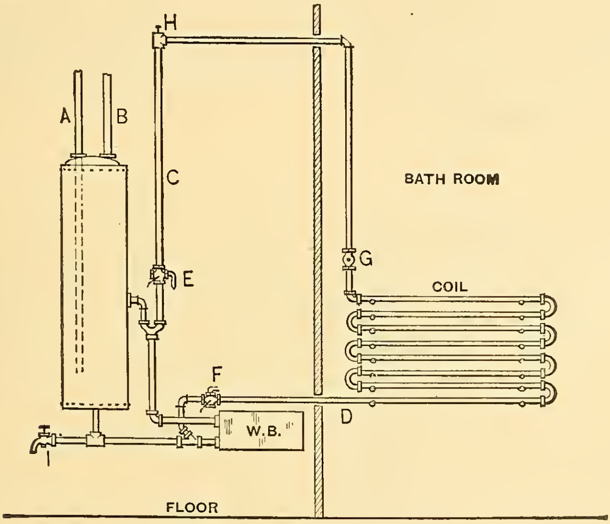
From J. G., *Philadelphia, Pa.*—I would advise "F. P.," East Fairfield, Vt., to arrange his radiator and circulating boiler as shown in the inclosed sketch. He should use not less than 1-inch circulating pipe, and locate at the highest point of the top circulating pipe to radiator a vapor pipe of about 3/8 inch internal diameter, and carry it to a point above the supply tank of the boiler or into the hot water pipe, as shown in dotted lines. In running the pipes care should be taken to grade them, so that no steam or air can be lodged in them. This arrangement will give all the circulation he desires at the radiator and also at the boiler, if the water front is a good one. The angle valve marked "A" may be opened for summer use when the radiator is not required. If both the radiator connections are at the bottom of the radiator, then he must run an air pipe from the top of radiator and connect it with the air pipe shown in the sketch.

RADIATOR ON A LEVEL WITH WATER BACK.

From S. & M., *Americus, Ga.*—Inclosed you will find a small sketch of a residence in this place. What we want to know is, can we heat the bathroom by using a small radiator supplied from the kitchen hot water boiler? We think it can be done and would like to have your idea about it. We want it so arranged that the radiator can be used or not, as in the summer time no heat is required.

Answer.—When the bathroom is on the floor above the range there is no difficulty in heating it from the range water back, provided the heating surface in the back is great enough. In this case the bathroom is on the same floor with the range, and we fear our correspondents will experience some trouble in obtaining satisfactory results on that account. The water in the coil will be of comparatively low temperature under such conditions, and we advise our correspondents not to use less than 50 feet of 1-inch pipe in the coil, and to employ the largest water back that will fit the fire box of the

range, unless the range is larger than No. 8. A coil is preferable to a radiator in this case, as the radiator would stand upon the floor, thereby leaving a great portion of its surface below the water back, which would practically destroy the circulation. A coil looks quite as neat at one altitude as another when it is properly installed, and may be placed entirely above the wainscoting if there is not room below to place it without getting more than two pipes of the coil below the bottom connection of the water back. We have made an engraving to illustrate the principal requirements of the work in



Radiator on a Level with Water Back.

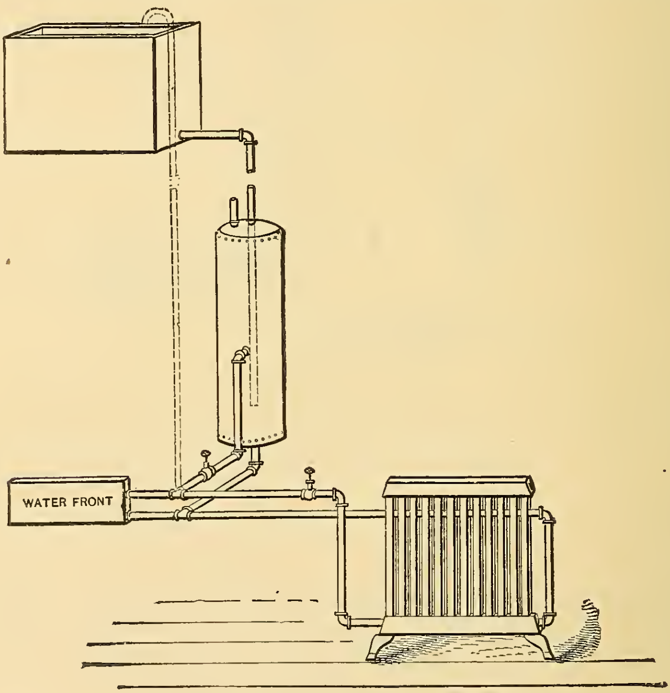
question, and while it does not show the pipes in their normal positions, it will aid the reader in understanding what is needed. The coil may be placed where sufficient suitable wall space is available. The reference letters are as follows: A, cold supply to boiler; B, hot supply to fixtures; C, supply to coil; D, return from coil; E and F, stop and waste cocks on supply and return of coil. The waste is on the coil side in both cases. G is a valve, by which to regulate the flow. This should be a key valve; H is an air cock at the highest point of the flow to coil; I, sediment cock. To fill the coil without entrapping air, open E, F, G and H, and then turn on cold water to boiler. When water issues from air cock H, close it.

From J. G., *Philadelphia, Pa.*—I notice the reply to S. & M. Now, why not locate the boiler in the bathroom? Why not locate a 4-inch pipe in the corner, or at the cornice of the ceiling, and use it as a radiator and also for storage of water? If necessary, put a 4-inch pipe at both sides of the bathroom, in angle where side walls join the ceiling, and use these pipes both for storage and radiation.

Note.—Our correspondent's idea is certainly a novel one, but it must be remembered that the heat in summer would be disagreeable.

RADIATOR LOWER THAN WATER FRONT.

From S. H. J., *Sumner, Iowa.*—I wish to ask through the columns of *The Metal Worker* if the proposed plan, as shown in the inclosed drawing, would



Radiator Lower than Water Front.

prove a success. The drawing represents the water front and range boiler as I have it connected, also the supply tank. With heavy fire the room becomes too warm. My idea is to utilize this extra heat by connecting the water front to a

radiator in another room, using a globe valve to shut the water off from hot water boiler and leave the cold water pipe open. Will this give me circulation through the radiator?

Answer.—We reproduce our correspondent's sketch in the engraving. Radiators placed below the water front, as shown, do not generally give satisfaction so far as circulation is concerned. If the bottom of the radiator were placed above the top of water front and the flow and return pipe between back and radiator connected up without traps, satisfactory circulation would be attained. The valves may be placed as shown by our correspondent, but care should be taken not to leave the two valves shut at the same time, because such an occurrence would cause steam and water to be blown into the supply tank or steam might be produced in water front to the extent of allowing it to become overheated.

HEATING RADIATOR OR BOILER.

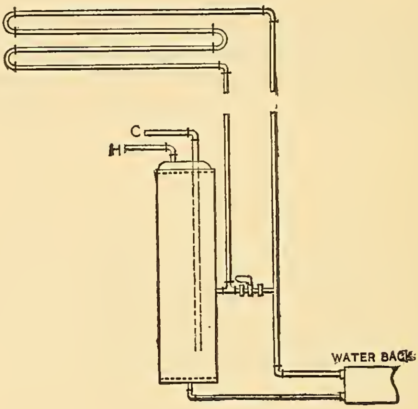
From A. H. H., *Ludlow, Mass.*—I wish to inquire if a system for heating a room from water front will work if I take the supply direct from the range by a Y-branch at the side opening in the boiler instead of from the top of the boiler, shutting off the boiler entirely and using the hot water for heating only. On the other hand, when a hot water supply is required, can I shut off from the coil and let the water circulate through the boiler as usual?

Answer.—Our correspondent proposes to divide each pipe connecting the water front and boiler, running one branch of the flow and return direct to the radiator in the room above, and the other branches to the range boiler in the usual manner, so that by the use of stop cocks the water can be used either for heating purposes or household supply. This is practicable, and would give excellent results, as either the radiator or the range boiler may be shut off and the full efficiency of the water back secured for whichever is in use.

From G. F. S., *Washington, D. C.*—I wish to inform "A. H. H." that the plan he refers to will work better than any other in use. All he has to do is to put a stop cock between the boiler and rising pipe, as shown in the sketch sent herewith, and he will have perfect control over the circulation. The boiler will get hot from the return water after passing through the coil.

Note.—The sketch sent by our correspondent is reproduced in the accompanying illustration. What he says bears out the remarks

made in our comment upon "A. H. H.'s" letter. The only criticism we would make is that having but one stop cock, as shown in the sketch, it will be impossible to entirely shut off the heat from the coil in the upper room, and this would be disagreeable in warm weather when the range is being used. By putting another stop cock in the riser to the coil all circulation would be practically shut off, though to make the stoppage complete it would be necessary to put a valve in both the riser and return from the coil. Even as it is, the circulation will be very light when the cock shown in the sketch



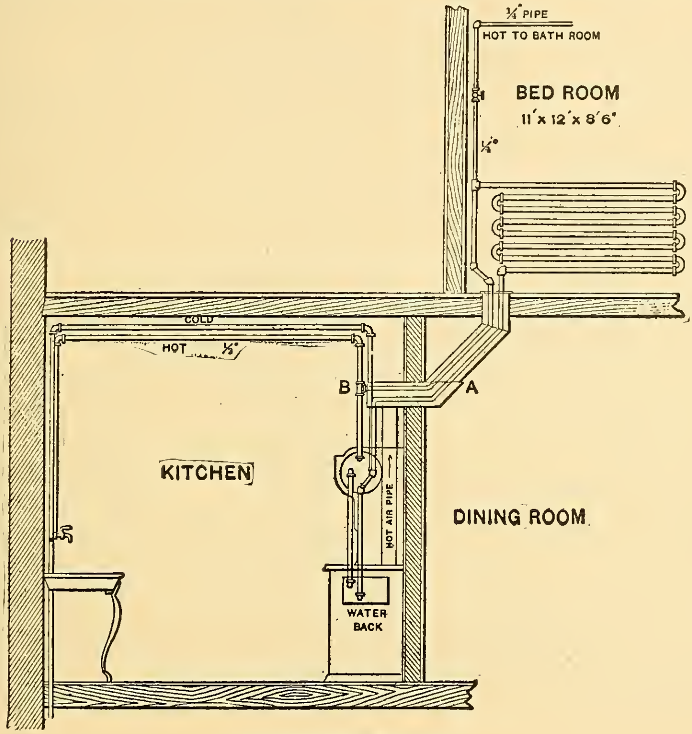
Heating Radiator or Boiler.

is open; but we think it would be quite perceptible in warm weather. Circulation takes place even where a pipe does not make a complete circuit, as would be the case if a stop cock were in either the flow or return from the coil. This very sluggish circulation is caused by a small column of water rising in the center of the pipe, and being cooled as it ascends, drops down the sides of the pipe. Another way to shut off the coil by using one stop cock would be to fill the coil with air during the summer months.

UTILIZING SURPLUS HEAT.

From Experimenter, *Pennsylvania.*—Having been a reader of *The Metal Worker* for upward of 18 years and gleaned many good ideas from its pages, I have concluded to describe some of my ex-

periences with heating an overhead room with the surplus heat of a portable range. Two years ago I decided to purchase a range adapted for that purpose. After examining four different makes, I found it rather difficult to decide which one to select as the most efficient and economical, but finally selected a range in which the hot air outlet was somewhat larger than that of the others; also be-



Utilizing Surplus Heat.

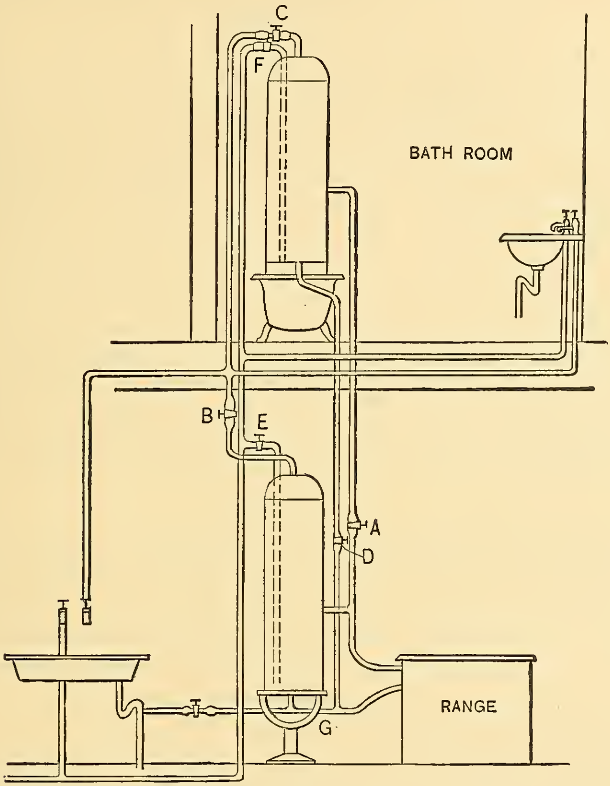
cause the hot air attachment was an independent feature, placed on the end of a complete range, so that it could not possibly chill the oven, which it is claimed is the case with some heating ranges. After placing the range in position and connecting the hot and cold water pipes, I cut a hole through the partition and floor, putting in a 5 x 8¾ inch square pipe, to which I connected the 3½ x 8½ inch oval hot air pipe from range. At A on the sketch a hinge cover (not shown in detail) was placed, which when closed threw the heat

upstairs. On opening this cover and closing the damper in square pipe, the hot air was thrown into the dining room. The result was quite gratifying. As the family did not use much hot water and the fire was kept burning briskly at all times, the water in the boiler boiled and at times generated steam. The thought suggested itself that a coil could be placed upstairs, and by leaving the door to back room open assist in keeping it warm. After some search a second hand coil, consisting of 40 feet of 1-inch pipe, was secured. This was rather more pipe than was requisite, but being averse to spending any time on alterations I concluded to risk it. The coil was placed in position and a tee was placed on the cold water pipe from the boiler to the water back, and a pipe with two 45° ells carried high enough to clear the other pipes, thence up through hot air pipes and connected with bottom pipe of coil, which made the return pipe. At B another tee was inserted and carried up alongside of return pipe to top of coil, and connected with a reducer tee to coil. Here a ¼-inch pipe was attached and extended to bathtub, primarily as an air vent, but later developed into a luxury, as a tubful of hot water could be drawn in 15 minutes. On flow and return pipes globe valves were placed to cut off circulation when desired. From the accompanying sketch it appears as though the connections were direct; such is, however, not the case. The coil stands parallel with the partition and was drawn thus to obviate the necessity of making another view, and there are eight angles and ells on both flow and return pipes. The result exceeded expectations as far as heating the two rooms was concerned, but in a family where considerable hot water is used it would not prove quite so satisfactory. A coil consisting of the same number of feet of ¾-inch pipe would have been a perfect job. I trust this experiment will be of some service to a brother chip.

HEATING WITH KITCHEN BOILERS.

From H. M., *Elizabeth, N. J.*—I present herewith a sketch of a proposed arrangement for heating a bathroom, and will be glad to have the readers of *The Metal Worker* express their views as to whether it will work satisfactorily and suggest any changes that would improve it. There is nothing new in putting the kitchen boiler upstairs in the bathroom or the bedroom to warm it during

the cool season, as it is done frequently in different parts of the country. The objection, however, is that in the hot weather it makes the bedroom warmer than desirable, and if placed in a small bathroom will make it disagreeably hot. To put a radiator connected with the kitchen boiler in the upper room will accomplish the same



Heating with Kitchen Boilers.

result so far as warming is concerned, but would cost about the same as an additional boiler to be placed in the upper room to be used when desirable; consequently I have designed the system shown. I propose to support in the corner of the bathroom, just above the bathtub, an additional boiler to the one used in connection with the range in the kitchen, piping it as shown. I bring the cold water supply from the cellar up and connect with both

boilers, putting stop cocks at E and F. I connect the hot water service pipes from both boilers to the general hot water service piping of the building, putting stop cocks at B and C. By this means I can shut off the water supply from either boiler that is not in use, so that when the upper boiler is used in the winter season I can shut off the stop cock E on the lower boiler and prevent the water it may contain from being forced from it through the system. Closing the stop cock B prevents a circulation passing down through the lower boiler and down through the water back, making the upper boiler work entirely independent of the lower one. In order to prevent a circulation through the upper boiler during the summer season stop cocks are put on the circulating and return pipes at A and D. I assume that when these two cocks are open the circulation will take place through the upper boiler without going through the lower boiler, and would like to ask if it will be necessary to use a stop cock on the pipe between the lower boiler and the water back at the point marked G. This will make a good many stop cocks, and if not used intelligently the expansion when heat is applied to the cold water in the system might wreck some part of it. If there are any means by which some of the stop cocks can be omitted I shall be glad to receive suggestions from the readers of *The Metal Worker*.

From E. C. S., *Holyoke*, *Mass.*—I have been waiting to reply to the inquiry of "H. M." until I could look over a similar job some distance from here which I once saw and could talk with the people who lived in the house and the man who did the work. Using a boiler to heat an upper room has been proven efficient, in fact, too much so in summer, and the novelty of the proposed plan is the use of two boilers. Where the fire and water back have sufficient power to heat the necessary water a radiator in the upper room is preferred as more sightly, and the piping arrangement that is most satisfactory takes the hot water from the top of the boiler to the radiator and returns the water to the lower water back connection.

The job I visited had two boilers and two ranges. There was a range and a boiler on the ground floor kitchen and also in the kitchen immediately above in a two-family house. This house has been occupied by one family for several years and, in order to supply hot water to the upstairs fixtures, the upstairs boiler has been connected with the downstairs water back just as "H. M." proposes, by run-

ning pipes up and connecting with the pipes between the boiler and water back, and when the stop cocks at the top of the lower boiler are closed there will be no need of a stop cock on the cold water pipe from the lower boiler. The proposed use of two boilers should prove satisfactory if the stop cocks are controlled intelligently.

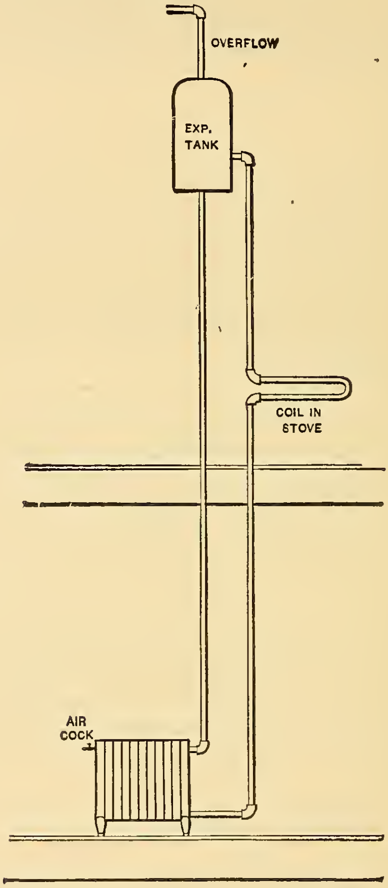
HEATING RADIATOR BELOW RANGE BOILER.

From E. J. A., *Carrolltown, Pa.*—I would like to get a little information in regard to heating my shop with hot water. My shop is in a basement and I had intended to have the pipe connected with a kitchen boiler which is on the next floor above. What I would like to know is, would the water circulate through the pipes? What makes me think that it would not is that the hot water is on top and the cold water in the pipe below would not let the hot water down to do the heating.

Answer.—It is doubtful if a very large shop could be heated from a kitchen boiler. An increase in the heating capacity of the water back in a stove might add to the complications rather than relieve them, by causing steam to generate if the circulation was slow. Examples of heating kitchen boilers located in a basement below a water back have been shown in *The Metal Worker*, and if a boiler can be heated below the water back it is reasonable to suppose that a radiator might be heated if placed below the boiler with which it was connected. The size of the shop and the size of the radiator would have an important bearing on its success. The method of piping would also be an important factor in securing a circulation that would insure successful heating.

From H. & O., *Dennison, Iowa.*—I contribute the following answer to "E. J. A.," who asked how to heat his shop with a radiator below a coil. If he will carry his flow pipe up from coil to an expansion tank above the coil and enter the expansion tank on the side, then drop from the bottom of the expansion tank to the top of the radiator, and bring the return from the bottom of the radiator back to the stove coil, he will have a perfect working system without noise. He must keep the water in the expansion tank above the entrance of the flow pipe, so it can circulate. An air cock should be

used on the top of the radiator to keep it free from air. Then he will have what is known as the Baker system, as I understand it. I



Heating Radiator Below Range Boiler.

submit herewith a sketch so he can understand better what I allude to.

From C. M. L., *Utica, N. Y.*—I have just finished reading "H. & O.'s" description of a system for heating with radiator below a range boiler. It seems to me that if "E. J. A." follows the details

given he will be seriously disappointed in the results. The illustration shows the bottom of the radiator to be one and a half times lower than the normal water line in the tank is higher than the

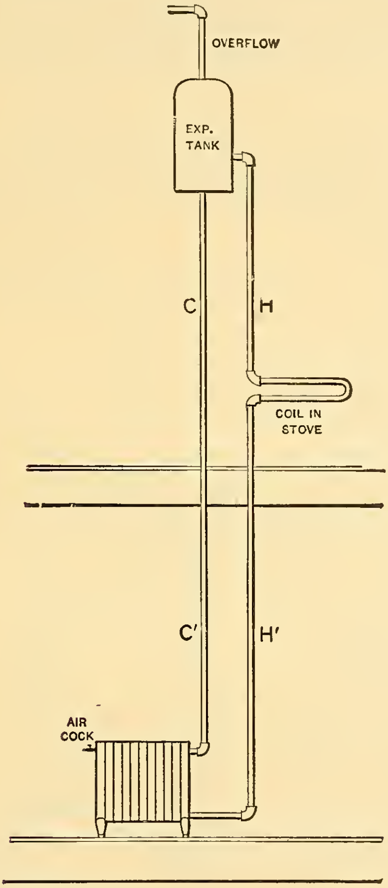


Fig. 1.—The System That Is Under Discussion.

water back. In other words, three-fifths of the total hight of the water column is below the water back. Now the only motive power in hot water heating is the difference in weight in the two columns due to the difference in the specific gravity of cold and heated water. It is readily understood that when the system illustrated in Fig. 1 is

filled with cold water before any heat is applied the water will not circulate, both columns being at equilibrium. Applying heat in the water back and heating the water in H decreases its density or specific gravity, and it is immediately forced upward by the preponderance of weight of cold water in C and C′, and a circulation is commenced. This circulation, however, will cease just the instant

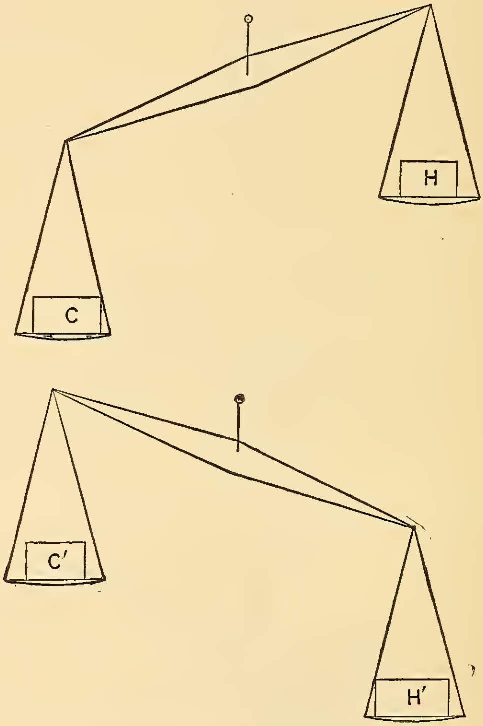


Fig. 2.—Scales Illustrating Principle Involved.

the water in C′ becomes warmer—that is, lighter—than a corresponding column of water in H′, for then, the weight of the water in H′ being in excess of that in C′, that portion of the system would circulate, if it could circulate at all, in the opposite direction. We then have two forces working against each other and resulting in equilibrium—that is, no circulation. This may be illustrated by conceiving the water as being balanced by weight as illustrated in Fig. 2; then $C + C'$ will equal $H + H'$. If the expansion tank were

carried high enough a point would be reached where the weight of $C + C'$ would exceed that of $H + H'$, and the circulation would then take place. Again, granted the proper elevation so that the circulation is established, the air cock illustrated and alluded to is unnecessary for the radiator, as all other portions of the system will free themselves of air through the vent outlet of the expansion tank.

HEATING FROM WATER BACK.

From W. M. W., *Lititz, Pa.*—I am a reader of *The Metal Worker* and see many plans of heating with hot water which are of interest, and now I have

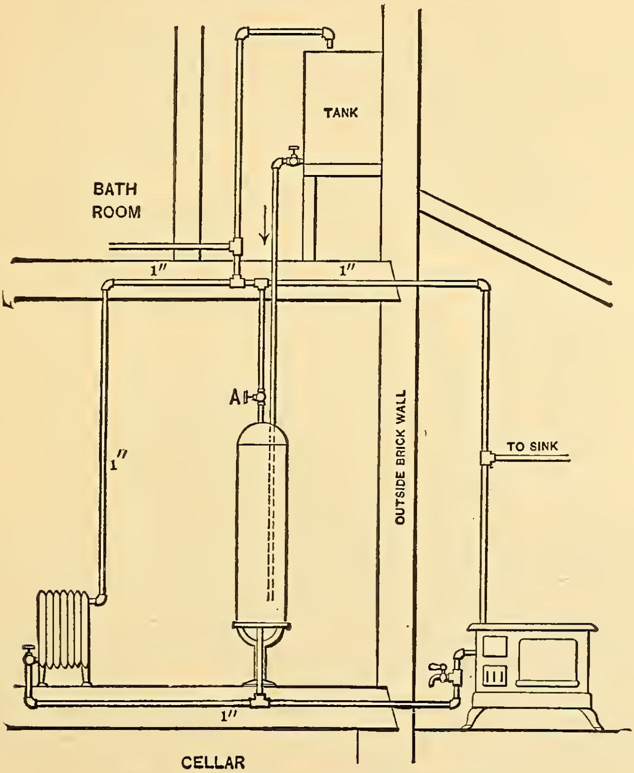


Fig. 1.—The Proposed Piping Arrangement.

some work in view on which I would like a little information. I wish to heat a room with hot water and propose to pipe the job as shown in Fig. 1, and would

like to know if there would be a circulation through the radiators when the globe valve at A at the top of the boiler is shut off. There is very little hot water used from the boiler and the globe valve at A will shut the boiler out of the system. The pipes which supply the sink and the bathroom are connected as shown. I know from experience that I can make all the hot water that is needed. A No. 7 large square portable range is used for the work, and I have reinforced the water back as shown in Fig. 2. The water back has a horizontal partition extending from one end nearly to the other. The return pipe from the system connects at one end below this partition. Just over the return opening is the hot water outlet, but this I have plugged, and have tapped the water back on the top as shown. A nipple connects this opening with an ell, which is connected by another nipple to a tee, from which the flow pipe is taken. I have tapped the opposite end of this water back for

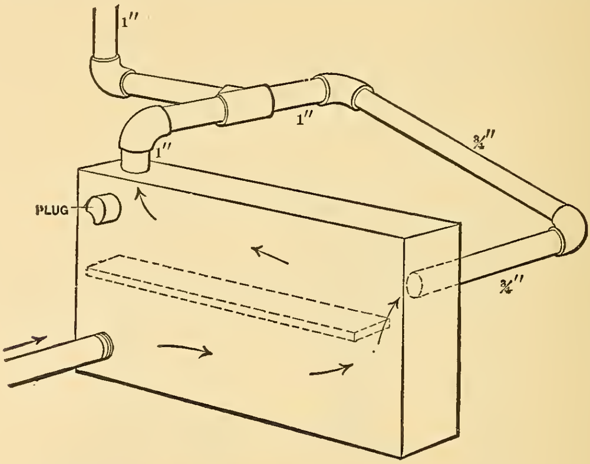


Fig. 2.—Water Back Reinforced for Heating.

a ¾-inch pipe which runs across the end of the fire chamber and then the length of the fire chamber, where it takes a turn and connects with the tee, thus reinforcing the heating power of the water back. By tapping the water back on the top it affords a relief, so that there would be no accumulation of air or steam at any time in the water back. I have also placed a relief pipe at the highest point in the system, which connects with the tank on the floor above the range.

I should also like to know why the upper coil in the heating system shown in Fig. 3 is the last to get hot. This system works perfectly as far as heating is concerned, but I do not understand why the upper coil does not get hot first.

Answer.—There will be no difficulty in securing circulation through the radiator shown in Fig. 1 when the valve A is closed, shutting off the hot water from circulating through the boiler. If

only a small quantity of water is drawn out at the sink or in the bathroom it will make but little difference in the heating system. If any considerable quantity of water is drawn off it will naturally be replaced with cold water and will reduce the efficiency of the heating system until the water has become heated. The method of reinforcing or increasing the capacity of the water back shown in

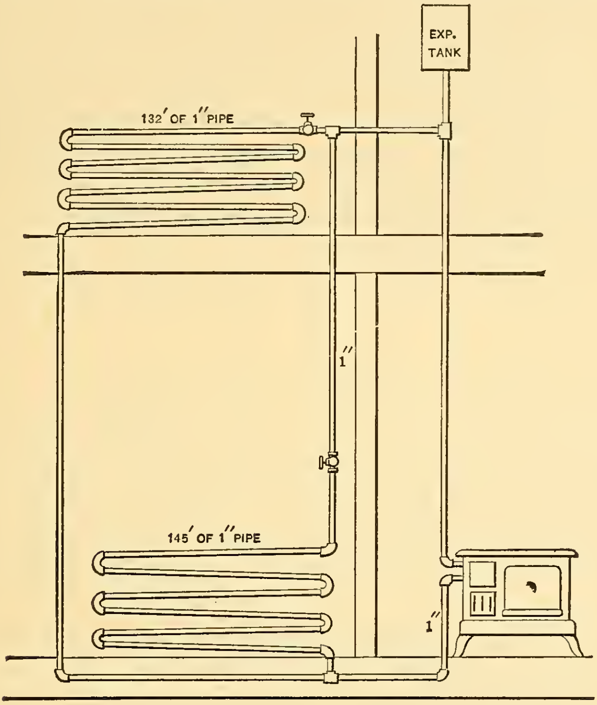


Fig. 3.—Lower Radiator Heats First.

Fig. 2 should be very efficient, and is worthy of remembrance by those who occasionally have trouble in furnishing a sufficient quantity of hot water.

The fact that the system shown in Fig. 3 heats satisfactorily makes unnecessary any changes in the piping, though a more even distribution of the hot water would be effected by the use of 1¼-inch pipe in the flow and return up to the point where the branches are connected or ¾-inch branches were used. Some practical

authorities on hot water heating limit a trombone coil when used for a radiator to 100 lineal feet of 1-inch pipe, and when more must be used prefer manifold fittings to secure quick circulation and even heating, as they reduce the travel and the friction. In this case the lower radiator or coil heats owing to the larger body of cold water in it reaching the water back more readily when the fire starts circulation. As the heated water flows out the cold water enters, and it is not uncommon for the circulation to establish a short circuit when the piping is not arranged to prevent it. In this case, the pipes being all of one size, there is nothing to force the flow to be distributed and the return to be drawn alike from both coils. If dissatisfaction had been reported the flow of hot water could be readily controlled in this case by partially closing the valve on the lower coil, forcing more water through the upper coil.

CHAPTER XII.

RADIATORS HEATED FROM COILS IN STOVES.

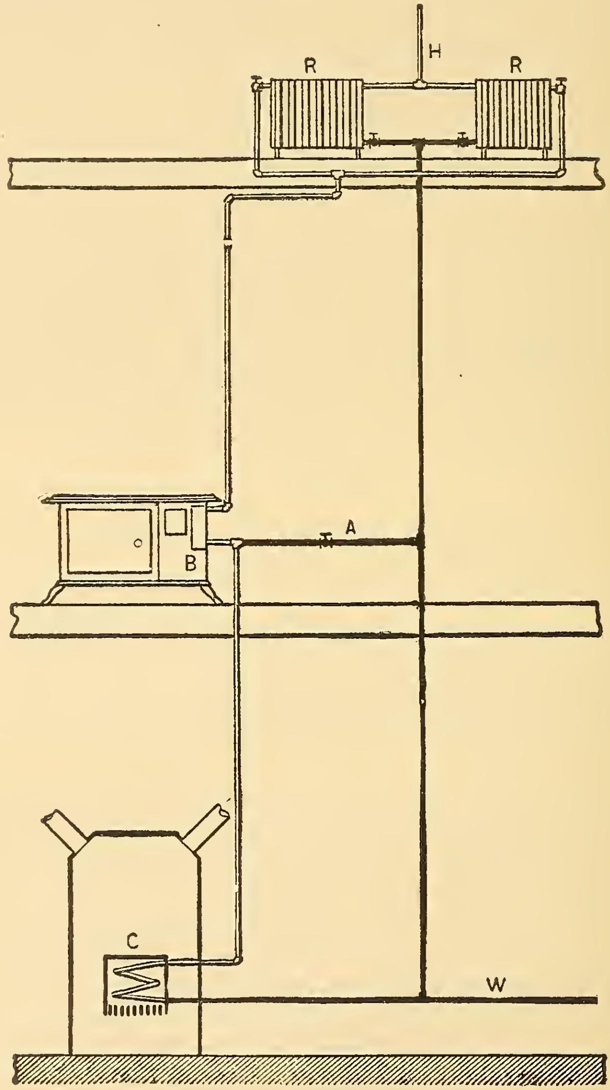
Coils are frequently used in stoves for heating water for use in radiators in other rooms than those in which the stove is placed, and their use has been attended with satisfaction when the heating capacity of the stove, the size of the coil and the size of the radiator have been correctly proportioned. In piping the same rules must be observed as those given for radiators connected with kitchen boilers, but an expansion tank will always be necessary.

AUXILIARY HEATING SYSTEM.

From A. B., *Cleveland, Ohio.*—Can a hot water tank be left out and a hot water radiator substituted to heat a bathroom? Is there any objection to passing a double "S" wrought iron pipe into fire pot of hot air furnace, and then carrying the same to a hot water radiator in hall, and thence to kitchen range, and thus having two radiators for carrying supply of hot water, besides using them for aiding the hot air furnace to heat the house? Also what objection, if any, is there to having a modern appliance using gas burners for heating water for bath purposes in summer?

Answer.—A radiator may be substituted for a hot water boiler or tank, and will circulate from back in kitchen range if placed above the range. The flow from back may be connected to opening in radiator at bottom or top of it, and the return from radiator to back should be taken from bottom of radiator. The hot water supply pipe should be taken from top of radiator, and the cold water supply can be connected to some point on the return pipe between radiator and back. This cold water supply pipe can be taken from tank or town water supply, either of which will provide for expansion, the pressure in radiator and back being the same as the pressure due to tank or town supply.

A coil of pipe, or what is termed a water back, may be placed in fire pot of hot air furnace. If the furnace is in cellar below back in kitchen range, connect the flow pipe from coil in furnace to re-



Auxiliary Heating System.

turn opening or lower opening in back in range, and continue the return pipe from radiator to return opening in coil or back in fire pot of furnace. The accompanying sketch gives a general idea of the principles on which the pipes may be arranged. When the kitchen range is not in use the circulation passes through the back from coil in furnace to radiators, and the valve in pipe A should be closed. This valve in pipe A need only be opened when the kitchen range is used alone and there is no fire in furnace. The reservoir for hot water is of much less capacity in two radiators than in an ordinary boiler or tank. There is no objection to the use of hot water heaters with gas burners for bath purposes in the summer.

In the cut the double lines denote flow or hot wat r pip s, and the heavy single lines return or cold water pipes. A is return pipe to range water back with gate valve ; B, water back in range ; C, pipe coil in furnace fire pot ; R R, radiators with angle flow valves and gate return valves ; H, hot water supply to bathtub ; W, cold water supply from tank or street main.

EXPANSION TANK AND RANGE BOILER.

From T. O. M., *Adams, N. Y.*—I see in *The Metal Worker* recently plans for setting range boilers in which you illustrate an expansion tank or something of the kind. How would you arrange pipes to make them entirely safe where the boiler is connected with the city water works, the pressure being 50 pounds to the square inch?

Answer.—When the water supply to the boiler is connected with the city or pressure mains, and the water back in the range and the boiler are used for heating radiators and for domestic purposes, the expansion tank is not necessary, as the pressure in the radiator, boiler or water back will not exceed that in the mains, and the expansion of the water can act against this pressure. If the desire is to avoid pressure a supply tank should be used connected to the cold water supply pipe to the boiler, and with ball cock to regulate the supply to the tank from the pressure main. This supply tank will act as an expansion tank. By this means the heavy pressure on the pipes within the building is obviated. Where a boiler is not used and the water back is used for heating a radiator on a heating system that is filled once, and then a continual supply shut off, an expansion tank must be provided.

FURNACE COIL AND RADIATOR.

From H., *East Orange, N. J.*—Will you please inform me through *The Metal Worker* how many square feet of radiating surface will be required to heat two rooms, one 19 x 15 feet, the other 11 x 11 feet, each with ceilings 9 feet high and having 30 and 40 square feet of glass respectively. The room 19 x 15 feet is a back parlor, connected by an opening, but no door, with a front parlor of same size, which contains a register. There is a door between the back parlor and the small room and the intention is to place a radiator in each room. How many square feet of heating surface must be put in a coil or generator to be placed in a hot air furnace to supply hot water to the radiators for the rooms?

Answer.—So many of the conditions that should be taken into account in answering such a question are missing that a strictly accurate answer cannot be made. There are many rules in use for apportioning radiating surface, the majority of which take into delicate consideration every possible condition and are as combersome as they are safe and correct. These could not be used with the information at hand, consequently the rule used is that which requires from 30 to 50 cubic feet of space to be heated by each square foot of radiating surface. This requires judgment in application. If the building is of a character to retain heat and is surrounded by other buildings and the room in question exposes but one wall to the weather, the radiating surface might be safely required to heat the full limit, while if the reverse was the case the small limit might be taxed. Our correspondent must use his judgment in his application, but for example we will use 40 feet, and as there are 2565 cubic feet in the parlor it will require 64 square feet, and there being 1089 cubic feet in the small room it will require 27 square feet, making a total of 91 square feet of radiating surface required for the two rooms. In deciding the amount of surface that will be needed in the heating coil there are as many rules and variations in opinions as in apportioning radiating surface. If the coil is made of 1-inch pipe and is placed in the furnace just above the level of the fire, and where the products of combustion have full effect, the amount of radiating surface that each square foot of the coil will carry varies from 20 to 30 feet, according to different authorities. Some go higher yet, as a 1-inch coil is looked upon as an excellent heater when exposed above a large grate area, as we suppose it would be in this case. As the grate area is not known to us, we shall expect our correspondent to again use his judgment in determining this amount. In order to

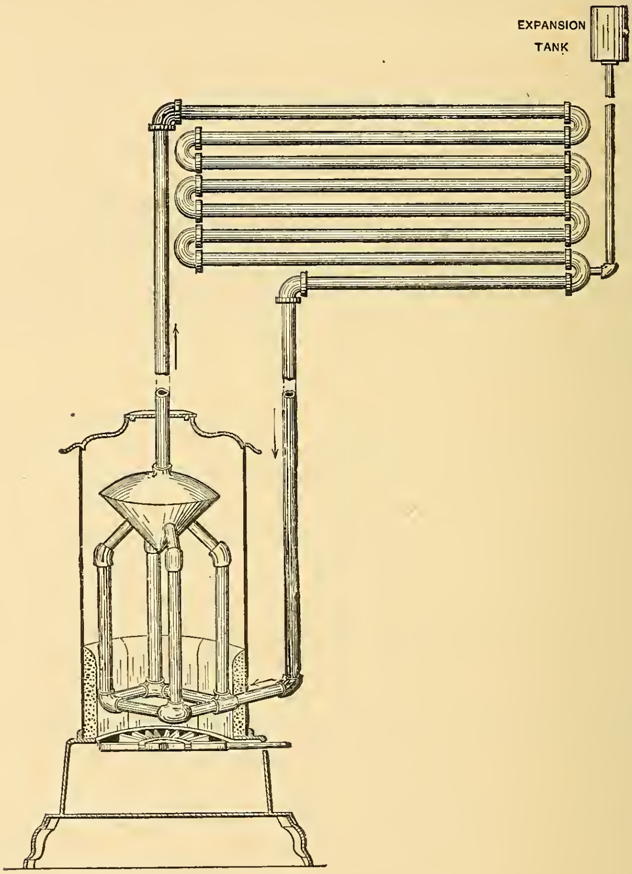
give an example we will use 25 feet, which means each square foot of coil surface must heat 25 feet of radiating surface. As there are 91 feet of radiating surface, we find, by dividing it by 25, that there must be 3½ square feet in the coil, and as the piping will lose some heat, it might be well to put 4 square feet of surface in it, or about 12 lineal feet of 1-inch pipe.

AN APPRENTICE'S WATER HEATER.

From C. M., *Preston, Md.*—I am an apprentice and wish to surprise my employers, but need a little assistance and apply to *The Metal Worker* for information. I have a room on a third floor that I want to heat for a workshop. How many feet of 1½-inch pipe made into a wall coil would be required to heat by hot water radiation a 20 x 26 x 10 foot room. Also give rule for other sizes of pipe. I want to heat this room from a 13-inch cylinder stove by having four 1½-inch pipes run down as far as the grate and connect as shown in the illustration and to be connected up above the fire by a hot water dome 10 inches in diameter and 6 inches deep. The stove is shown with the water heater in it, and the radiator and expansion tank.

Answer.—To decide correctly the amount of surface necessary to heat a room is not possible without the fullest details as to the character of the building, its exposure, glass surface, &c. Even then the rules require much judgment in their application. Without detailed information the rule of heating from 30 to 50 cubic feet of space with each square foot of heating surface seems to be the only way in this case to approximate the surface. Our correspondent must use his judgment in determining whether the room will be difficult or not to heat. In order to give an answer, 1 square foot of radiating surface will be decided necessary for 40 cubic feet of space, and as the room in question contains 5200 cubic feet it will require 130 square feet of heating surface. The distance the water has to travel will cause it to lose so much heat in transit that it is possible that the water in the coil would not be of a temperature that would enable this amount of surface to prove satisfactory. This contingency must be considered in apportioning the surface and more given if it is deemed necessary. There are 144 square inches in 1 square foot, and the circumference of 1½-inch pipe is nearly 6 inches. By dividing 144 inches by 6 inches it is found that a piece of 1½-inch pipe 24 inches or 2 feet long exposes 1 square foot of surface, and by multiplying the 130 feet of surface by 2 the number of lineal feet of pipe essary to make this coil will be found to be 260. The number of

square feet of heating surface that 1 square foot of fire surface in a coil will heat varies from 20 to 30 or more feet with different authorities. Using 25 for an example and allowing for some cooling in the flow and return pipes, there should be 6 square feet of surface in the



An Apprentice's Water Heater.

heating coil. If a coil was used 12 lineal feet of 1½-inch pipe would be required. A general impression prevails that a coil should be cone shaped and should not come in contact with the coals for durability and highest efficiency, but should be suspended just above them, subject to their radiant heat and the full play of the flame and

hot gases. The device of our ambitious young friend is open to some criticism owing to its being partly in the fire, and it is just possible that it will lack the necessary heating surface and power. Another important point to be considered is the grate area. If no other service was expected of the fire than the heating of the coil and the stove was covered with a material to retain the heat generated and a steady fire kept up it is probable that no difficulty would be experienced in heating the upper room. If the stove has been selected as being just of the right power for the lower room the extra work will be too much for its capacity.

HEATING STORE FROM COIL IN STOVE.

From W. W. W., *Casopolis, Mich.*—We have a store room, 24 x 70 feet, facing east, in a brick building, and it also has brick buildings on each side. Our tin shop is up stairs, at the front end, and is 24 x 28 x 14 feet in size. I would like to know if I can heat it with hot water by putting a 20-inch coil of 1¼-inch pipe in a wood stove that is down stairs, and if so, how much of the coil would I need to supply the amount of radiation I would have to heat the shop. Do you think it would be economical to heat it by this method?

Answer.—Our correspondent will require in the stove about 10 square feet of fire surface in pipes, or about 23 to 25 lineal feet of 1¼-inch pipe—that is, a coil five high of 1¼-inch pipe, by about 20 inches in diameter—to supply the amount of radiation required in the tin shop mentioned. Space should be left between the pipes in the coil, so that the heat will come in contact with the greater part of the surfaces, and the pipes should be well inclined. Heating the tin shop, which is above the stove in the store, by hot water circulation can be easily done, and it is certainly more economical than an extra stove in the shop.

FURNACE COIL AND CONSERVATORY.

From E. & H., *Oshawa, Ontario.*—In connection with a dwelling house in which we have placed a hot air furnace, the owner put up a conservatory, 40 x 12 x 7 feet high, forming a leanto against the east side of the dwelling, which he proposed to heat by hot water by placing a coil of pipe in the furnace. Now, what size coil will be required, or what rule is there for determining the amount of surface to be exposed to the fire to heat a given number of cubic feet of air?

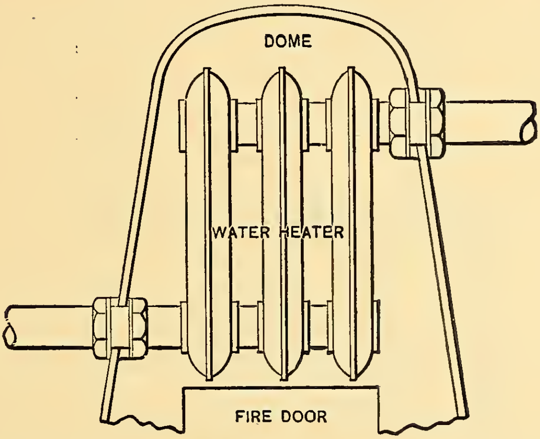
Answer.—The application of the cubic foot rule in apportioning heating surface requires so much personal judgment, even in house

heating, that many authorities discard it altogether. In greenhouse heating it is seldom or never used, the heating surface required being computed from the glass surface exposed, 1 square foot of heating surface being used for 2, 3 or 4 square feet of glass surface, according to the temperature of the water in the heating pipes. In the greenhouse mentioned there is, let us assume, an exposure of 760 square feet of glass surface, and in order to make sure of its being heated, with the water at a temperature of 160°, 1 square foot of heating surface will be calculated to heat 2½ square feet of glass surface. Consequently about 300 square feet of heating surface will be required in the greenhouse. The heating capacity of coils placed in hot air furnaces varies very materially, so that the use of any rule to determine this has proved unsatisfactory, except when used with considerable judgment. An approximate rule, which has given satisfaction, is to allow 1 square foot of coil surface to 30 square feet of heating surface. In this case a coil containing 10 square feet of surface would be required, and 2-inch pipe is the best to use to connect with the piping necessary to supply the amount of heating surface required. About 1.6 lineal feet of 2-inch pipe are required to give a surface of 1 square foot. In heating greenhouses and conservatories the heating surface is generally placed in coils either along the walls or under the flower benches and less than 2-inch pipe is seldom used, while many advise the use of 4-inch pipe.

HEATING RADIATOR WITH FURNACE.

From I. J. N., *Bethlehem, Pa.*—I have used with excellent success a far cheaper arrangement than a coil, which is a section of a radiator, and where several square feet of surface are required two to three sections may be used. In order that the use of the radiator or water heater may be better understood I submit a sketch of the dome of a cast iron furnace, with sections of a three-column radiator connected together, and with the flow and return connections. Radiator sections can be bought of different hights, and I have used in a number of instances three-column radiators that were 18 inches high and exposed about 2⅓ square feet of surface per section. This will give about 7 square feet of surface in a water heater built of three sections on this plan. I have estimated the value of this character of heating surface in a hot air furnace the same as the ordinary prac-

tice of estimating the value of heating surface in house heating boilers, which is about 12 feet of radiation to 1 square foot of surface in the heater, so that a water heater of this size would carry 84 feet of radiation. This, however, is a conservative rating, and a much greater amount of surface can be safely carried. I would advise, however, that each man use his judgment in estimating the heating power in accordance with the size of the fire pot and the size of the combustion chamber in which such a water heater is used. If such a heater is used in a fire pot that is 30 inches in diameter, and the combustion chamber is large, it is probable that each square foot of surface would carry 20 to 30 feet of radiation. Those who are



Heating Radiator with Furnace.

familiar with pipe fitting and the use of radiators can readily see that a water heater made out of a radiator is far cheaper than one made of pipe.

HOT WATER SUPPLY AND HEATING A BARN.

Following is the method of heating and supplying hot water for a barn designed by F. C. Weiant & Co.: An elevation of the system of piping is given in Fig. 1, show how the stove is arranged for heating the water which is used for heating the radiator in the coachman's room, shown in Fig. 2, and in the waiting room on the lower

floor. The stove is of the sheet iron construction, 16 inches in diameter, the fire bricks which ordinarily line the chamber having been re-

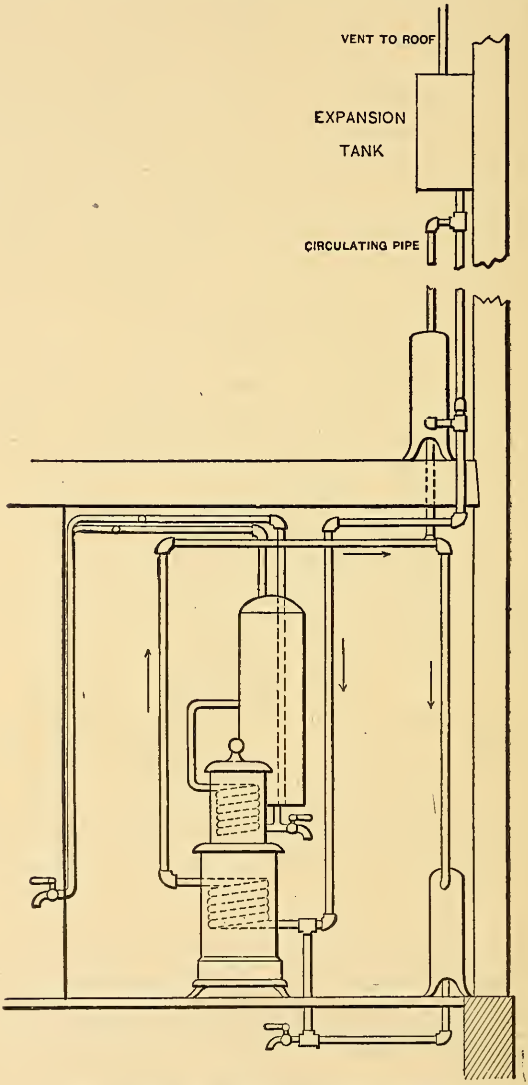


Fig. 1.—Elevation Showing Heating Apparatus.

moved and a coil composed of 17 lineal feet of 1½ inch pipe being substituted for them. This coil presents about 9 square feet of heat-

ing surface, and owing to the fact that to protect the sheet iron body of the stove the coil is packed in fire clay it is calculated that 1 square foot of surface will take care of about 15 feet of radiation, and counting the surface exposed in the piping to the expansion tank and in the radiators and the piping to them, and the fact that these pipes are exposed for heating the barn, the total amount of surface exposed by them is about 120 feet, a 36-foot radiator being placed in the coachman's room and a radiator having 40 square feet of surface being placed in the waiting room.

The upper part of the stove body is reduced by means of a cast iron ring to 14 inches in diameter. In this portion of the body a coil composed of ten loops of ¾-inch pipe is placed. This coil con-

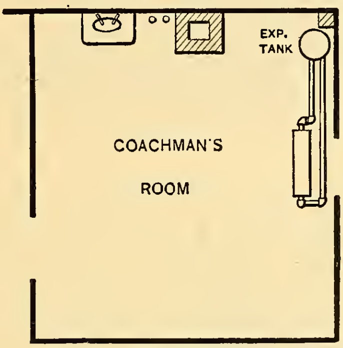


Fig. 2.—Coachman's Room, with Radiator and Expansion Tank.

tains 37 lineal feet, exposing about 8 square feet of heating surface, and is used for heating a 40-gallon boiler. It is ordinarily figured that a coil exposed above a fire will heat from 25 to 30 feet of radiation per square foot of surface, and from one-half to two-thirds as many gallons of water as it will carry feet of radiation, but owing to this coil being suspended so high above the fire it is estimated that 1 square foot of surface would not heat more than 10 to 12 feet of radiation, depending upon the condition of the fire. This would equal about 80 to 96 feet of radiation; and calculating that it would heat one-half as many gallons of water as feet of radiation, it would seem that a 40-gallon boiler is about the right tax for the coil, and in this instance there has not been any difficulty at any time in securing an ample supply of hot water for tempering the water at the drinking trough, for supplying the lavatory in the coachman's

room and for tempering the water for washing the carriages so that the varnish is not cracked. This supply of hot water for washing the carriages and for drinking is also of great comfort to the coachman in his work and to the animals being watered.

At the carriage wash a combination fixture is used so that either all cold water or all hot water or tempered water can be supplied as desired. A draw off cock is placed on the pipe where the return from the boiler connects with the heating coil, and there is also a draw off cock on the return from the hot water heating system at the lowest point, so that in case of necessity the hot water service and the heating system can be thoroughly drained. The expansion tank is connected with the return of the radiator in the coachman's room, and a circulating pipe is carried from the flow pipe to this radiator to the pipe of the expansion tank, as shown. This is to provide a circulation of water to prevent the possibility of the expansion tank freezing and putting the system under a pressure, when the expansion from heating the water might be sufficient to wreck the system.

HEATING A BARBER SHOP.

From W. F. S., *Bayfield, Wis.*—I send herewith a plan, shown in Fig. 1, of a barber shop which the proprietor wishes to have heated with hot water from his bath boiler. The building is 13 feet front, 31 feet deep and has a 9-foot ceiling. It has two stories and is plastered, but the upper rooms are not occupied. The front is mostly of glass, amounting to a space 7 x 13 feet. On the plan there is shown a 66-gallon galvanized iron boiler and a 16-inch Wilks heater. The heater is tapped on the top for two 1 ½-inch connections, and tapped on the sides near the bottom with four 1 ½-inch holes. Where is it best to connect the flow pipe—from the top of the boiler or from one of the unused holes in the top of the heater? Where should the return pipes be connected? What size of pipe should I use for the flow and return from the heating coil, and where should the heating coil be placed? What shape and size should the heating coil be? It will be noticed that the back part of the building is divided into three rooms, two of which are bathrooms, and that the partition is only 7 feet high, leaving a space of 2 feet between the top of the partition and the ceiling for a circulation of air. The building faces north, and the space along the west side is occupied by chairs for the waiting customers.

Answer.—Considering the amount of heating surface that will be exposed by the heater, the boiler and the piping to and from the heating coil, it is quite probable that a coil, placed along the north end of the room, exposing 100 feet of surface, will be ample to secure a comfortable temperature. In order to make the circulation

easy a 1½-inch flow pipe will probably be best. This should run up to a point a few inches below the ceiling, as shown in Fig. 2, where it should run into a tee in the top of which an air valve should be connected. From the side of the tee a flow main of the full size

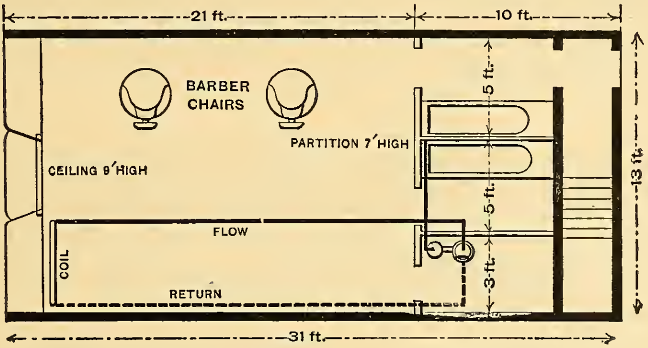


Fig. 1.—Floor Plan.

should be run over to the heating coil. It is quite probable that a radiator will be more ornamental and satisfactory, but either a manifold coil made of 1-inch pipes or a return-bend coil made of 1½-inch pipes will render good service. The return from the

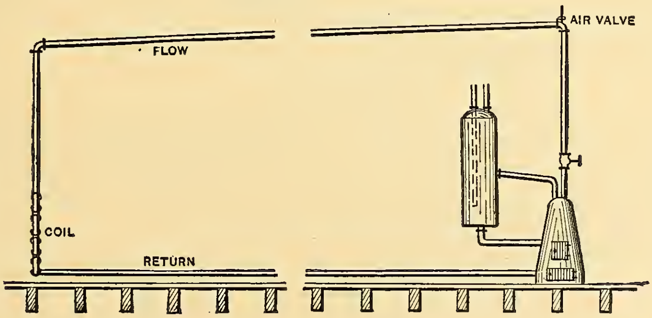


Fig. 2.—Method of Piping.

radiator can readily be run along the floor on the west side, back of the waiting chairs, and where it comes into the small room where the heater and boiler are located it can be run across and connected at one of the openings in the side of the heater. Two lineal feet of 1½-inch pipe exposes 1 square foot of heating surface, and if a

radiator exposing 100 square feet of surface is used 200 lineal feet of pipe will be required. If 1-inch pipe is used 3 lineal feet of pipe exposes 1 square foot of surface, and 300 lineal feet of 1 inch pipe will be needed. As the water heater will be connected to the boiler any expansion of water will work against the supply to the boiler, whether that be city pressure or tank pressure, and an expansion tank will not be necessary.

From W. F. S., *Bayfield, Wis.*—I would like to ask another question in reference to heating the barber shop about which I asked for assistance and received it. Would a quicker and better circulation result if the flow pipe was highest at the downward turn just above the heating coil and at a pitch from the air valve to that point where it now has a fall? This would make the air valve lower than the elbow above the coil and would necessitate the air valve being changed to that point.

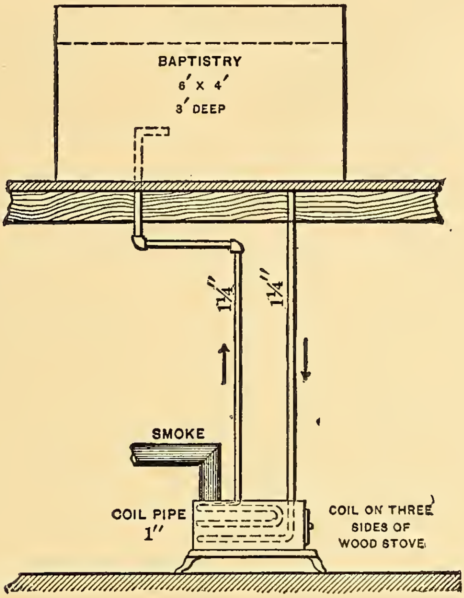
Answer.—It is quite possible that very little difference would result from changing the pitch of the pipe in the plant discussed. The idea of having a fall from the point where the air valve is located is based on the fact that the water will be hottest when it reaches this point, and from there it will cool and consequently have a tendency to fall away, inducing a better circulation than if the cooling water had to flow up hill. In larger plants, with a longer run of pipe, it is the general opinion that it is best to have a fall from some high point.

From W. F. S., *Bayfield, Wis.*—The hot water heating job which I placed in a barber shop in accordance with instruction received in *The Metal Worker* is giving entire satisfaction with the mercury from 10 to 15 degrees below zero.

HEATING A BAPTISTERY.

From E. & R., *Walton, N. Y.*—We were called upon to do a job in the Baptist church here, a description of which may interest your readers. The tank was about 4 x 6 feet in size and was ordinarily filled about 3 feet deep with water. As a cheap and effective job was wanted, we endeavored to meet the requirements in the follow-

ing manner: We took a small box stove for wood and put a coil around three sides of it and connected the coil direct with the tank, the same as we would a hot water boiler. The result was good and the job has given perfect satisfaction ever since, doing the work quickly and well. We provided a draw off cock at the lowest point, so that the system can be entirely emptied and left free so that it



How Should a Baptistery Be Heated?

will not freeze. The sketch shows the manner in which the pipe coil was placed in the stove and the manner in which it was connected with the tank. The coil in the stove was made of 1-inch pipe and the main and return pipes were made of 1¼-inch pipe.

THE END.

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